Electronic Supplementary Information

Synthesis of Biaryl Ketones by Arylation of Weinreb Amides with Functionalized Grignard Reagents under Thermodynamic Control vs. Kinetic Control of N,N-Boc$_2$-Amides

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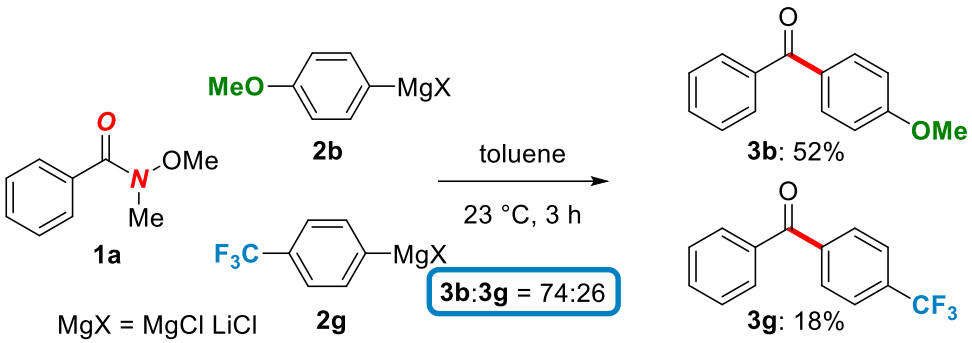
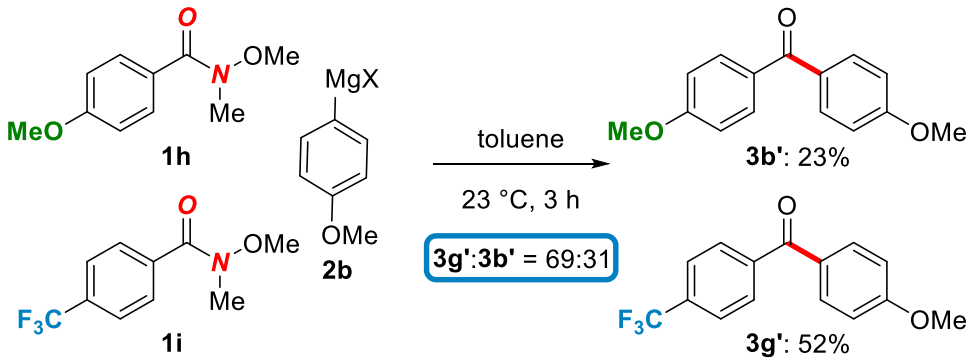
Mechanistic Studies Referred to from the Main Manuscript

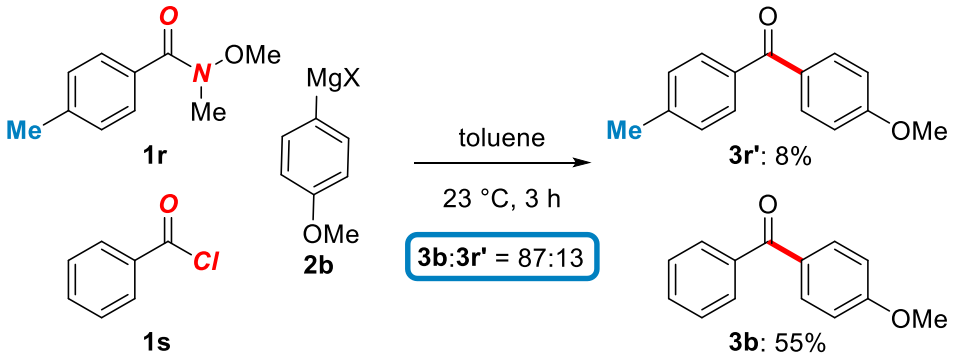
A series of studies were performed to gain insight into the reaction mechanism and investigate factors involved in controlling the amide acylation protocol (Schemes SI-1A-C).



Scheme S1-A. Intermolecular Competition Experiments: Grignard Reagents. *Conditions: **1** (1.0 equiv), organomagnesium reagent (1.0 equiv each), toluene (0.25 M), 23 °C, 3 h.*



Scheme S1-B. Intermolecular Competition Experiments: Amides. *Conditions: **1** (1.0 equiv each), organomagnesium reagent (1.0 equiv), toluene (0.25 M), 23 °C, 3 h.*



Scheme S1-C. Intermolecular Competition Experiments: Amides. *Conditions: **1** (1.0 equiv each), organomagnesium reagent (1.0 equiv), toluene (0.25 M), 23 °C, 3 h.*

List of Known Compounds/General Methods

All starting materials reported in the manuscript have been previously described in literature and prepared by the method reported previously, unless stated otherwise. Amides was prepared by standard methods.[1-10] All experiments were performed using standard Schlenk techniques under argon or nitrogen atmosphere unless stated otherwise. All solvents were purchased at the highest commercial grade and used as received or after purification by passing through activated alumina columns or distillation from sodium/benzophenone under nitrogen. All other chemicals were purchased at the highest commercial grade and used as received. Reaction glassware was oven-dried at 140 °C for at least 24 h or flame-dried prior to use, allowed to cool under vacuum and purged with argon or nitrogen (three cycles). All products were identified using ^{1}H NMR analysis and comparison with authentic samples. GC and/or GC/MS analysis was used for volatile products. All yields refer to yields determined by ^{1}H NMR and/or GC or GC/MS using an internal standard (optimization) and isolated yields (preparative runs) unless stated otherwise. ^{1}H NMR and ^{13}C NMR spectra were recorded in $CDCl_3$ on Bruker spectrometers at 500 (^{1}H NMR) and 125 MHz (^{13}C NMR). All shifts are reported in parts per million (ppm) relative to residual $CHCl_3$ peak (7.27 and 77.2 ppm, ^{1}H NMR and ^{13}C NMR, respectively). All coupling constants (J) are reported in hertz (Hz). Abbreviations are: s, singlet; d, doublet; t, triplet; q, quartet; brs, broad singlet. GC-MS chromatography was performed using Agilent HP6890 GC System and Agilent 5973A inert XL EI/CI MSD using helium as the carrier gas at a flow rate of 1 mL/min and an initial oven temperature of 50 °C. The injector temperature was 280 °C. The detector temperature was 280 °C. For runs with the initial oven temperature of 50 °C, temperature was increased with a 10 °C/min ramp after 50 °C hold for 3 min to a final temperature of 280 °C, then hold at 280 °C for 10 min (splitless mode of injection, total run time of 33.00 min). All flash chromatography was performed using silica gel, 60 Å, 300 mesh. TLC analysis was carried out on glass plates coated with silica gel 60 F254, 0.2 mm thickness. The plates were visualized using a 254 nm ultraviolet lamp or aqueous potassium permanganate solutions. *^{1}H NMR and ^{13}C NMR data are given for all compounds in the Supporting Experimental for characterization purposes. ^{1}H NMR, ^{13}C NMR and HRMS data are reported for all new compounds.*

Experimental Procedures and Characterization Data

General Procedure for Preparation of Grignard Reagents: All Grignard reagents were prepared according to the procedure of Knochel and co-workers (*Angew. Chem. Int. Ed.* **2004**, *43*, 3333) and titrated prior to use according to the method previously reported (*Synthesis* **2006**, 890). An oven-dried vial equipped with a stir bar was placed under a positive pressure of argon and subjected to three evacuation/backfilling cycles. The vial was charged with *i*-PrMgCl·LiCl (1.05 mL, 1.0 M in THF, 1.05 mmol), the reaction mixture was cooled to the indicated temperature, an aryl halide (1.0 mmol) was added in one portion, and the reaction was stirred for the indicated time. Organomagnesium reagents were titrated prior to use (*Synthesis* **2006**, 890).

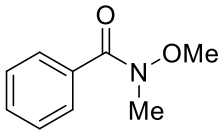
General Procedure for Acylation of Weinreb Amides with Functionalized Grignard Reagents. An oven-dried vial equipped with a stir bar was charged with an amide substrate (1.0 equiv) placed under a positive pressure of argon and subjected to three evacuation/backfilling cycles under argon. Toluene (0.25 M) and a freshly prepared solution of magnesium reagent (1.2 equiv) were sequentially added with vigorous stirring, and the reaction mixture was stirred for 3 h at room temperature. After the indicated time, the reaction mixture was quenched with NH_4Cl (aq., sat., 1.0 mL) and diluted with ethyl acetate (10 mL). The organic layer was washed with water (1 x 10 mL), brine (1 x 10 mL), dried, and concentrated. A sample was analyzed by ^1H NMR ($CDCl_3$, 500 MHz) and GC-MS to obtain conversion, yield and selectivity using internal standard and comparison with authentic samples. Purification by chromatography on silica gel (EtOAc/hexanes) afforded the title product.

Representative Procedure for Acylation of Weinreb Amides with Functionalized Grignard Reagents. Gram scale. An oven-dried vial equipped with a stir bar was charged with 4-fluoro-*N*-methoxy-*N*-methylbenzamide (1.00 g, 5.64 mmol, 1.0 equiv) placed under a positive pressure of argon, and subjected to three evacuation/backfilling cycles under argon. Toluene (0.25 M) and a freshly prepared solution of 4-*N*,*N*-diisopropylbenzamidemagnesium chloride/lithium chloride (6.77 mmol, 1.2 equiv) were sequentially added with vigorous stirring, and the reaction mixture was stirred for 3 h at room temperature. After the indicated time, the reaction mixture was

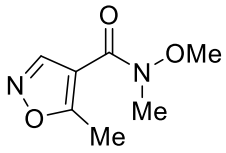
quenched with NH_4Cl (aq., sat., 30 mL), and concentrated. The residue was extracted with EtOAc (3 x 100 mL), the organic layers were combined, dried, and concentrated. Purification by chromatography on silica gel (EtOAc/hexanes) afforded the title product. White solid. Yield 78% (1.39 g). Characterization data are included in the section below.

Characterization Data of Amide Materials

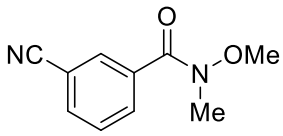
All amides used in this study were prepared by procedures reported in the literature. **1a**,[1] **1b**,[2] **1c**,[3] **1d**,[4] **1e**,[1] **1f**,[5] **1g**,[6] **1h**,[1] **1i**,[7] **1j**,[8] **1k**,[9] **1l**,[10] **1m**,[4] **1n**,[6] **1o**[10] have been previously reported. Spectroscopic data matched those reported in the literature.



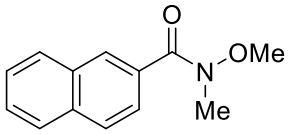
***N*-Methoxy-*N*-methylbenzamide (1a).** Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.71 – 7.57 (m, 2H), 7.52 – 7.32 (m, 3H), 3.56 (s, 3H), 3.37 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.96, 134.14, 130.56, 128.13, 128.01, 61.03, 33.79.



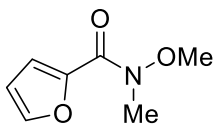
***N*-Methoxy-*N*,5-dimethylisoxazole-4-carboxamide (1b).** Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.53 (s, 1H), 3.69 (s, 3H), 3.34 (s, 3H), 2.71 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 175.06, 161.88, 149.42, 109.26, 61.36, 32.46, 12.94.



3-Cyano-*N*-methoxy-*N*-methylbenzamide (1c). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.94 (s, 1H), 7.87 (d, *J* = 7.9 Hz, 1H), 7.68 (d, *J* = 7.7 Hz, 1H), 7.48 (t, *J* = 7.8 Hz, 1H), 3.47 (s, 3H), 3.31 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 167.30, 135.19, 133.92, 132.69, 132.07, 129.04, 118.17, 112.39, 61.34, 33.27.

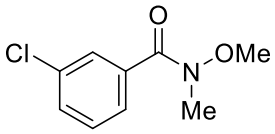


***N*-Methoxy-*N*-methyl-2-naphthamide (1d).** Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.25 (s, 1H), 7.95 – 7.85 (m, 3H), 7.80 – 7.75 (m, 1H), 7.60 – 7.50 (m, 2H), 3.59 (s, 3H), 3.44 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.91, 134.24, 132.51, 131.44, 128.85, 128.69, 127.72, 127.64, 127.41, 126.50, 125.09, 61.14, 33.88.

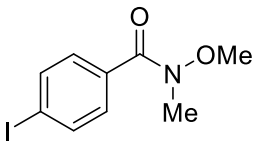


***N*-Methoxy-*N*-methylfuran-2-carboxamide (1e).** Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.57 (s, 1H), 7.12 (d, *J* = 3.4 Hz, 1H), 6.49 (dd, *J* = 3.2, 1.5 Hz, 1H),

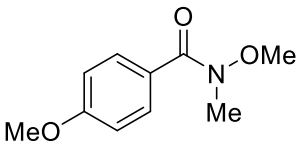
3.74 (s, 3H), 3.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 159.10, 145.64, 145.22, 117.36, 111.58, 61.34, 33.13.



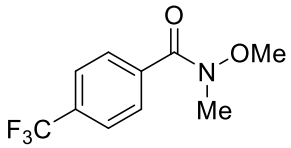
3-Chloro-*N*-methoxy-*N*-methylbenzamide (1f). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.68 (s, 1H), 7.57 (d, *J* = 7.4 Hz, 1H), 7.44 (d, *J* = 8.0 Hz, 1H), 7.35 (t, *J* = 7.8 Hz, 1H), 3.56 (s, 3H), 3.36 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.33, 135.74, 134.00, 130.66, 129.39, 128.38, 126.37, 61.20, 31.23.



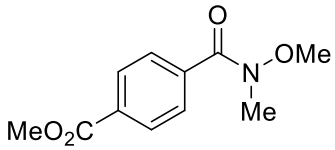
4-Iodo-*N*-methoxy-*N*-methylbenzamide (1g). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.68 (d, *J* = 8.5 Hz, 2H), 7.36 (d, *J* = 8.4 Hz, 2H), 3.46 (s, 3H), 3.28 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.91, 137.22, 133.41, 130.00, 97.36, 61.17, 31.24.



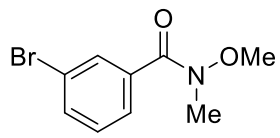
***N*,4-Dimethoxy-*N*-methylbenzamide (1h).** White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.9 Hz, 2H), 6.88 (d, *J* = 8.9 Hz, 2H), 3.81 (s, 3H), 3.53 (s, 3H), 3.32 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.35, 161.51, 130.50, 125.98, 113.22, 60.84, 55.28, 33.86.



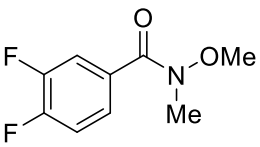
***N*-Methoxy-*N*-methyl-4-(trifluoromethyl)benzamide (1i).** Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.74 – 7.68 (m, 2H), 7.61 – 7.57 (m, 2H), 3.45 (s, 3H), 3.30 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.51, 137.56, 132.23 (q, J^F = 32.0 Hz), 128.55, 125.00 (q, J^F = 3.5 Hz), 123.75 (q, J^F = 272.4 Hz), 61.21, 33.29. ^{19}F NMR (470 MHz, $CDCl_3$) δ -63.01 (s).



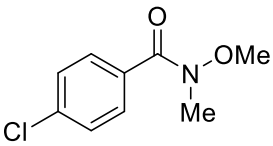
Methyl 4-(methoxy(methyl)carbamoyl)benzoate (1j). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.0 Hz, 2H), 7.74 (d, *J* = 8.0 Hz, 2H), 3.95 (s, 3H), 3.55 (s, 3H), 3.39 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.04, 166.44, 138.36, 131.79, 129.27, 128.09, 61.22, 52.34.



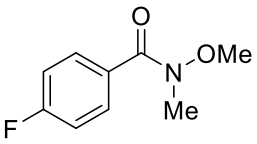
3-Bromo-*N*-methoxy-*N*-methylbenzamide (1k). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.81 (s, 1H), 7.59 (d, *J* = 7.7 Hz, 1H), 7.56 (d, *J* = 8.6 Hz, 1H), 7.26 (t, *J* = 7.9 Hz, 1H), 3.53 (s, 3H), 3.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.17, 135.91, 133.56, 131.21, 129.65, 126.80, 122.00, 61.21, 33.56.



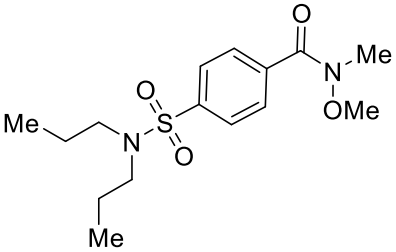
3,4-Difluoro-*N*-methoxy-*N*-methylbenzamide (1l). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.57 – 7.50 (m, 1H), 7.49 – 7.42 (m, 1H), 7.16 – 7.09 (m, 1H), 3.48 (s, 3H), 3.29 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 167.20, 167.20, 151.84 (J^1 = 253.3 Hz), 149.68 (J^1 = 249.0 Hz), 130.54 (J^3 = 5.1 Hz), 125.44 (J^2 = 6.9, J^3 =3.8 Hz), 118.22 (J^2 = 19.0 Hz), 116.99 (J^2 = 17.6 Hz), 61.18, 33.46. ^{19}F NMR (471 MHz, $CDCl_3$) δ -133.63, -137.34.



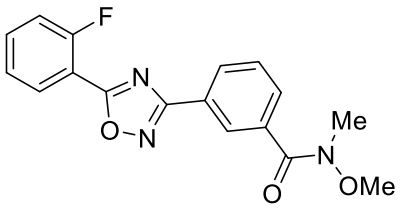
4-Chloro-*N*-methoxy-*N*-methylbenzamide (1m). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.58 (d, *J* = 8.4 Hz, 2H), 7.30 (d, *J* = 8.5 Hz, 2H), 3.46 (s, 3H), 3.28 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.66, 136.74, 132.31, 129.87, 128.28, 61.12, 33.52.



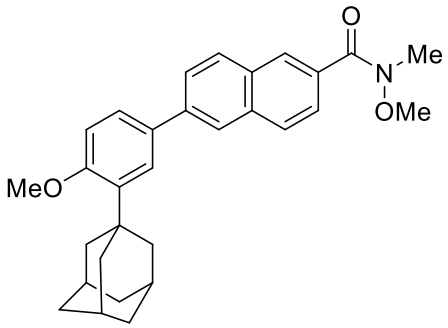
4-Fluoro-*N*-methoxy-*N*-methylbenzamide (1n). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.78 – 7.32 (m, 2H), 7.13 – 7.07 (m, 2H), 3.55 (s, 3H), 3.38 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.69, 164.05 (d, J^F = 251.0 Hz), 130.83 (d, J^F = 8.7 Hz), 129.95 (d, J^F = 3.3 Hz), 115.06 (d, J^F = 21.7 Hz), 61.03, 33.60. ^{19}F NMR (471 MHz, $CDCl_3$) δ -109.04.



4-(*N*,*N*-Dipropylsulfamoyl)-*N*-methoxy-*N*-methylbenzamide (1o). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.4 Hz, 2H), 7.79 (d, *J* = 8.3 Hz, 2H), 3.53 (s, 3H), 3.39 (s, 3H), 3.16 – 3.04 (m, 4H), 1.65 – 1.50 (m, 5H), 0.89 (t, *J* = 7.4 Hz, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 168.39, 141.96, 137.79, 128.77, 126.75, 61.30, 50.00, 33.96, 21.99, 11.17.



3-(5-(2-Fluorophenyl)-1,2,4-oxadiazol-3-yl)-*N*-methoxy-*N*-methylbenzamide (1p). *New compound.* White solid. Mp = 89-90 °C ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.44 (s, 1H), 8.21 (d, *J* = 7.8 Hz, 1H), 8.15 (t, *J* = 7.4 Hz, 1H), 7.77 (d, *J* = 7.7 Hz, 1H), 7.63 – 7.43 (m, 2H), 7.28 (t, *J* = 7.6 Hz, 1H), 7.25 – 7.20 (m, 1H), 3.53 (s, 3H), 3.33 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.96 (d, *J* = 4.4 Hz), 169.13, 168.24, 160.82 (d, *J* = 260.7 Hz), 134.98, 134.71 (d, *J* = 8.7 Hz), 130.97, 130.96, 129.50, 128.75, 127.38, 126.75, 124.75 (d, *J* = 3.7 Hz), 117.21 (d, *J* = 20.9 Hz), 112.78 (d, *J* = 11.4 Hz), 61.22, 33.66. ^{19}F NMR (471 MHz, $CDCl_3$) δ -108.22. HRMS calcd for $C_{17}H_{15}FN_3O_3$ (M + H) 328.1092, found 328.1089.

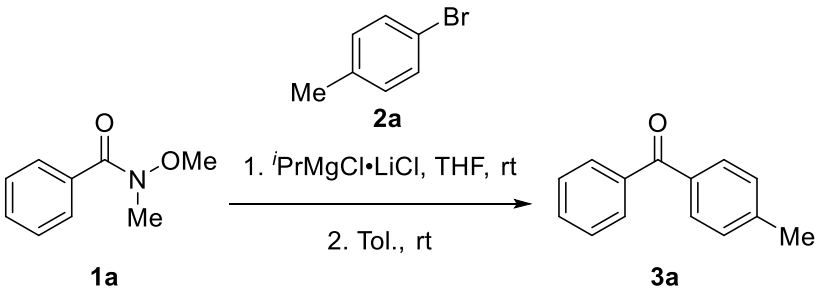


6-(3-(Adamantan-1-yl)-4-methoxyphenyl)-*N*-methoxy-*N*-methyl-2-naphthamide (1q). *New compound.* White solid. Mp = 186-187 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (s, 1H), 7.92 (s, 1H), 7.86 (d, *J* = 8.5 Hz, 1H), 7.82 (d, *J* = 8.6 Hz, 1H), 7.72 – 7.67 (m, 2H), 7.52 (d, *J* = 2.2 Hz, 1H), 7.46 (dd, *J* = 8.4, 2.2 Hz, 1H), 6.92 (d, *J* = 8.4 Hz, 1H), 3.83 (s, 3H), 3.51 (s, 3H), 3.35 (s, 3H), 2.11 (s, 6H), 2.03 (s, 3H), 1.73 (s, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.95, 158.82, 140.61, 138.98, 134.67, 132.78, 131.26, 130.91, 129.22, 128.58, 127.73, 126.36, 125.99, 125.70, 125.48, 124.74, 112.12, 61.14, 55.19, 40.63, 37.22, 37.16, 29.14. HRMS calcd for $C_{30}H_{34}NO_3$ (M + H) 456.2533, found 456.2528.

Characterization Data of Ketone Products

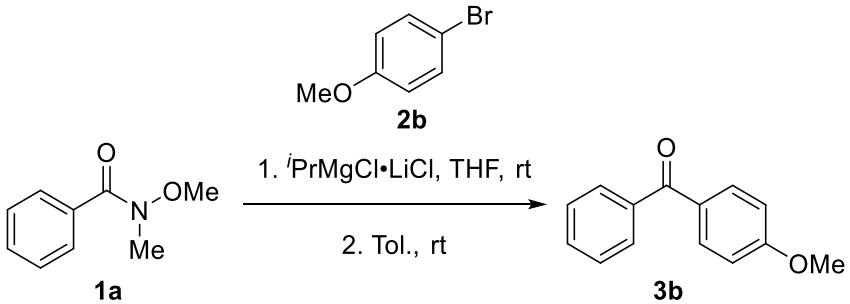
3a,[11] **3b**,[11] **3c**,[11] **3d**,[11] **3e**,[11] **3f**,[11] **3g**,[11] **3h**,[11] **3i**,[11] **3j**,[11] **3k**,[12] **3l**,[11] **3m**,[13] **3n**,[11] **3o**,[11] **3p**,[11] **3q**,[11] **3r**,[11] **3s**,[11] **3t**,[11] **3u**,[14] **3v**,[11] **3w**,[11] **3x**,[11] **3y**,[11] **3z**,[15] **3aa**,[16] **3ab**,[17] **3ac**,[11] **3ad**,[11] **3af**,[18] **3ah**,[11] **3ai**,[11] **3aj**,[19] **3ak**,[11] **3al**,[11] **3am**[11] have been previously reported, and prepared by a different, typically less synthetically and operationally convenient method. Spectroscopic data matched those reported in the literature.

Phenyl(*p*-tolyl)methanone (**3a**, Scheme 1)



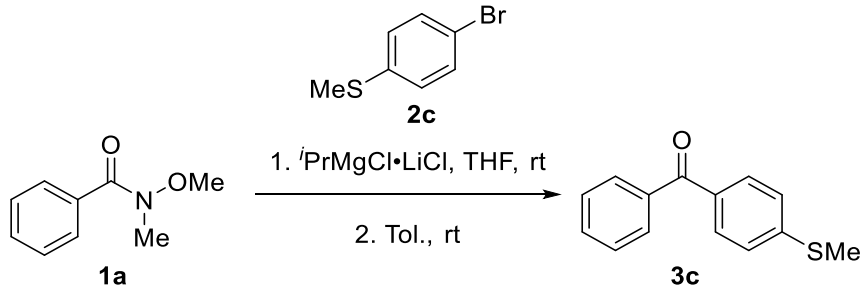
According to the general procedure, Br/Mg exchange was completed after 2 days at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared *p*-tolylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 90% yield (17.6 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.71 (d, *J* = 7.2 Hz, 2H), 7.65 (d, *J* = 8.0 Hz, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.6 Hz, 2H), 7.21 (d, *J* = 7.9 Hz, 2H), 2.37 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 196.53, 143.26, 137.98, 134.90, 132.18, 130.33, 129.95, 128.99, 128.23, 21.68.

(4-Methoxyphenyl)(phenyl)methanone (**3b**, Scheme 1)



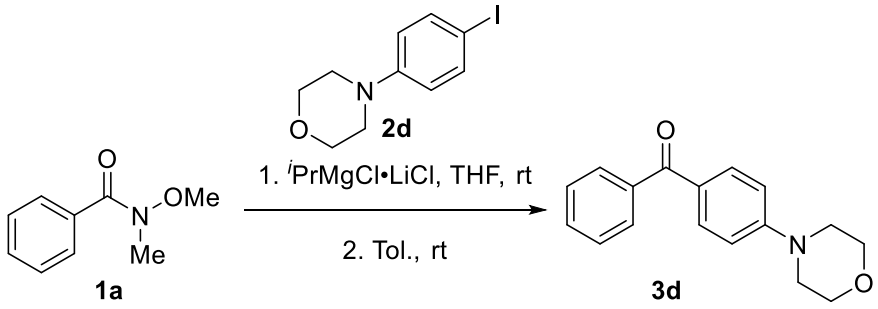
According to the general procedure, Br/Mg exchange was completed after 3 days at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-methoxyphenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 94% yield (19.9 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.4 Hz, 2H), 7.64 (d, *J* = 7.8 Hz, 2H), 7.45 (t, *J* = 7.4 Hz, 1H), 7.36 (t, *J* = 7.6 Hz, 2H), 6.85 (d, *J* = 8.2 Hz, 2H), 3.78 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.92, 162.58, 137.66, 131.92, 131.24, 129.53, 129.09, 127.54, 112.91, 54.86.

(4-(Methylthio)phenyl)(phenyl)methanone (**3c**, Scheme 1)



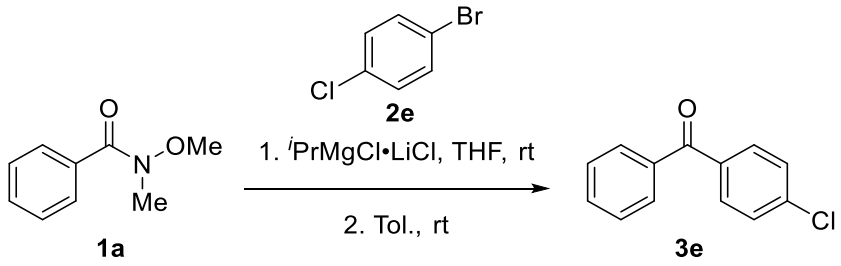
According to the general procedure, Br/Mg exchange was completed after 2 days at rt. The reaction *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-(methylthio)phenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 95% yield (21.7 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.706 – 7.654 (m, 4H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.40 (t, *J* = 7.7 Hz, 2H), 7.22 (d, *J* = 8.4 Hz, 2H), 2.46 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.84, 145.31, 137.88, 133.66, 132.21, 130.68, 129.85, 128.29, 124.86, 14.87.

(4-Morpholinophenyl)(phenyl)methanonePhenyl(*p*-tolyl)methanone (**3d**, Scheme 1)



According to the general procedure, I/Mg exchange was completed after 3 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-morpholinophenyl)magnesium chloride/lithium (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 75% yield (20.0 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.74 (d, *J* = 8.8 Hz, 2H), 7.67 (d, *J* = 7.2 Hz, 2H), 7.48 (t, *J* = 7.4 Hz, 1H), 7.39 (t, *J* = 7.5 Hz, 2H), 6.83 (d, *J* = 8.8 Hz, 2H), 3.84 – 3.78 (m, 4H), 3.30 – 3.23 (m, 4H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.29, 154.06, 138.73, 132.48, 131.57, 129.62, 128.13, 127.85, 113.21, 66.62, 47.60.

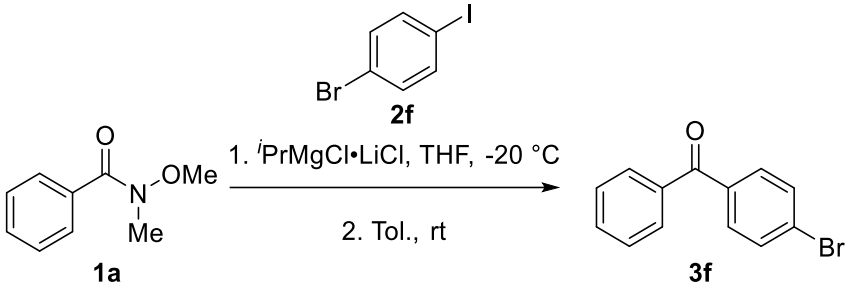
(4-Chlorophenyl)(phenyl)methanone (**3e**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-chlorophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 83% yield (17.9 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.77 (t, *J* = 7.9 Hz, 4H), 7.60 (t, *J* = 7.4 Hz, 1H), 7.48 (dd, *J* = 17.8, 8.2 Hz, 4H). ^{13}C

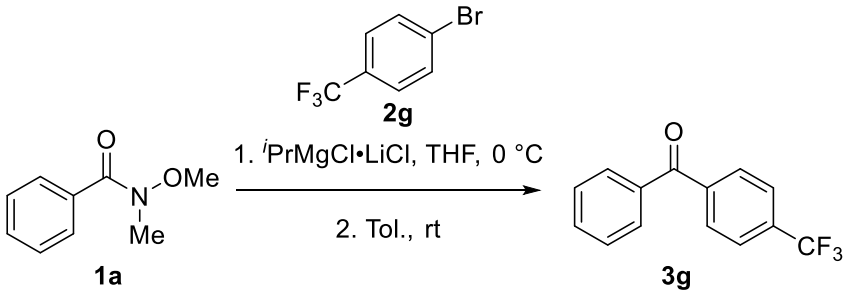
NMR (125 MHz, $CDCl_3$) δ 195.52, 138.92, 137.27, 135.89, 132.66, 131.48, 129.95, 128.66, 128.42.

(4-Bromophenyl)(phenyl)methanone (**3f**, Scheme 1)



According to the general procedure, I/Mg exchange was completed after 3 h at -20 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-bromophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 84% yield (21.8 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.79 (d, *J* = 7.2 Hz, 2H), 7.72 – 7.59 (m, 5H), 7.51 (t, *J* = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.67, 137.20, 136.33, 132.70, 131.64, 131.59, 129.96, 128.43, 127.54.

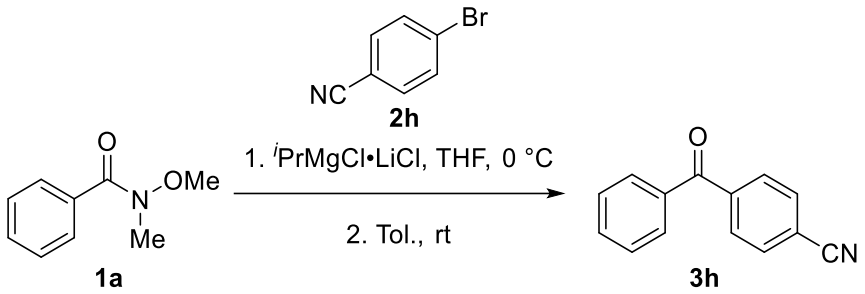
Phenyl(4-(trifluoromethyl)phenyl)methanone (**3g**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 h at 0 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-(trifluoromethyl)phenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 78% yield (19.5 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.0 Hz, 2H), 7.76 (d, *J* = 8.3 Hz, 2H), 7.71 (d, *J* = 8.1 Hz, 2H), 7.59

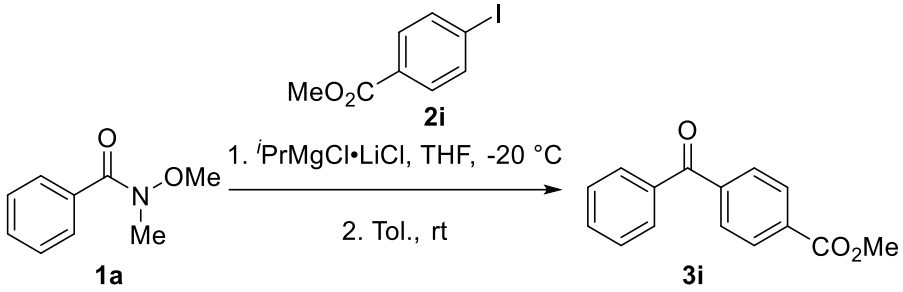
(t, J = 7.4 Hz, 1H), 7.47 (t, J = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 196.66, 141.87, 137.88, 134.86 (q, J^F = 32.6 Hz), 134.21, 131.26, 131.23, 129.66, 126.48 (q, J^F = 3.7 Hz), 124.81 (q, J^F = 274.9 Hz). ^{13}C NMR (125 MHz, $CDCl_3$) 123.69 (q, J^F = 274.9 Hz). ^{19}F NMR (471 MHz, $CDCl_3$) δ -60.80.

4-Benzoylbenzonitrile (**3h**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 2 h at 0 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-cyanophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 76% yield (15.7 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.88 (d, J = 8.3 Hz, 2H), 7.82 -7.77 (m, 4H), 7.64 (t, J = 7.4 Hz, 1H), 7.52 (t, J = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.06, 141.26, 136.35, 133.35, 132.1, 130.26, 130.09, 128.66, 118.03, 115.70.

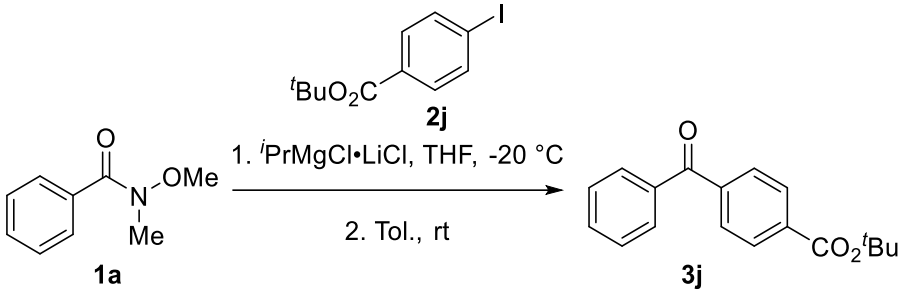
Methyl 4-benzoylbenzoate (**3i**, Scheme 1)



According to the general procedure, I/Mg exchange was completed after 1 h at -20 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-(methoxycarbonyl)phenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in

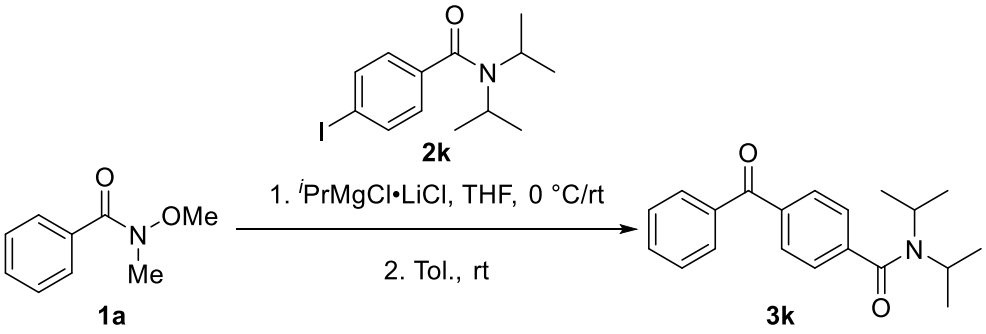
toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 53% yield (12.7 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.15 (d, *J* = 8.1 Hz, 2H), 7.84 (d, *J* = 8.1 Hz, 2H), 7.81 (d, *J* = 7.6 Hz, 2H), 7.62 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 3.97 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 198.06, 168.34, 143.34, 138.97, 135.24, 134.96, 132.1, 131.79, 131.52, 130.48, 54.49.

***tert*-Butyl 4-benzoylbenzoate** (**3j**, Scheme 1)



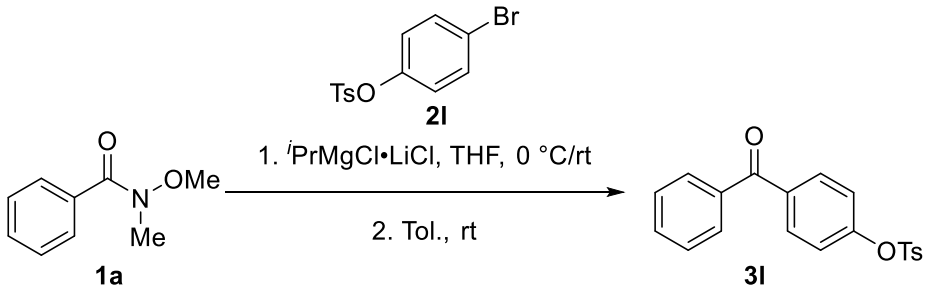
According to the general procedure, I/Mg exchange was completed after 1 h at -20 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-(*tert*-butoxycarbonyl)phenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 85% yield (24.0 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.10 (d, *J* = 7.9 Hz, 2H), 7.85 – 7.78 (m, 4H), 7.62 (t, *J* = 7.1 Hz, 1H), 7.50 (t, *J* = 7.5 Hz, 2H), 1.63 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 196.17, 164.95, 140.87, 137.12, 135.18, 132.86, 130.11, 129.67, 129.32, 128.43, 81.76, 28.18.

4-Benzoyl-*N*,*N*-diisopropylbenzamide (**3k**, Scheme 1)



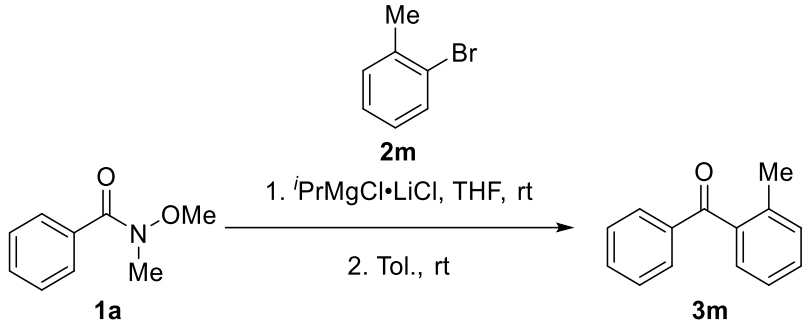
According to the general procedure, I/Mg exchange was completed after 1 h at -20 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared 4-*N*,*N*-diisopropylbenzamidemagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 75% yield (23.2 mg). *New compound.* Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.78 – 7.71 (m, 4H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.42 (t, *J* = 7.7 Hz, 2H), 7.34 (d, *J* = 8.2 Hz, 2H), 3.85 – 3.35 (M, 2H), 1.65 – 1.03 (M, 12H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 196.17, 169.95, 142.60, 137.71, 137.25, 132.69, 130.32, 130.08, 128.40, 125.53, 50.99, 45.97, 20.70. HRMS calcd for $C_{20}H_{24}NO_2$ (M + H) 310.1802, found 310.1797.

4-Benzoylphenyl 4-methylbenzenesulfonate (**3l**, Scheme 1)



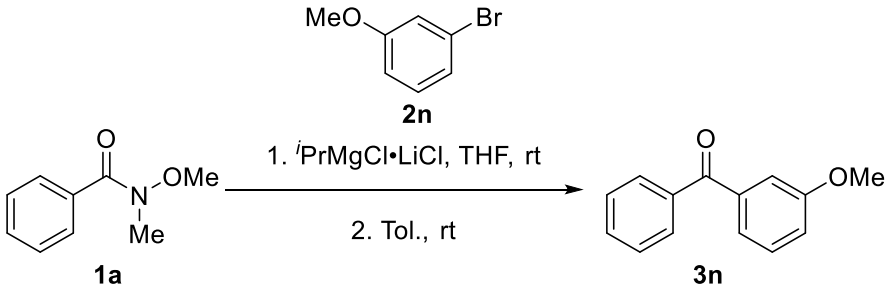
According to the general procedure, Br/Mg exchange was completed after 36 h at 0 °C to rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-(tosyloxy)phenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 93% yield (32.7 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.73 – 7.63 (m, 6H), 7.53 (t, *J* = 7.4 Hz, 1H), 7.41 (t, *J* = 7.7 Hz, 2H), 7.27 (d, *J* = 8.0 Hz, 2H), 7.04 (d, *J* = 8.7 Hz, 2H), 2.39 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.33, 152.52, 145.79, 137.11, 136.20, 132.75, 132.20, 131.74, 129.97, 129.95, 128.53, 128.43, 122.30, 21.77.

Phenyl(o-tolyl)methanone (**3m**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 days at room temperature. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared 2-methylbenzene magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 78% yield (15.3 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.73 (d, *J* = 7.1 Hz, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.38 (t, *J* = 7.7 Hz, 2H), 7.31 (t, *J* = 7.5 Hz, 1H), 7.25 - 7.198 (m, 2H), 7.16 (d, *J* = 7.5 Hz, 1H), 2.26 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 198.66, 138.64, 137.76, 136.77, 133.15, 131.01, 130.25, 130.15, 128.53, 128.48, 125.21, 20.00.

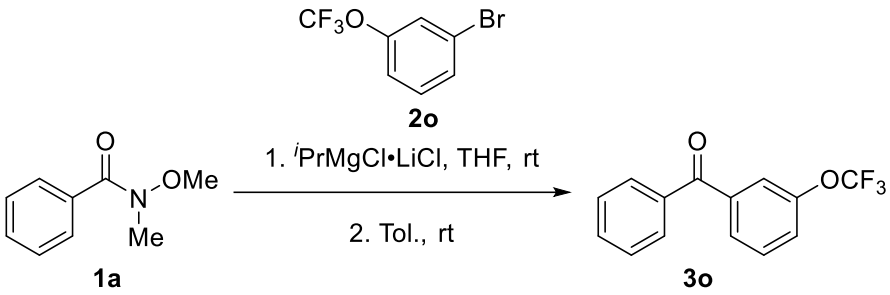
(3-Methoxyphenyl)(phenyl)methanone (**3n**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 days at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-methoxyphenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 96% yield (20.4 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.72 (d, *J* = 7.9 Hz, 2H), 7.50 (t, *J* = 7.1 Hz, 1H), 7.39 (t, *J* = 7.6 Hz, 2H), 7.31 – 7.23

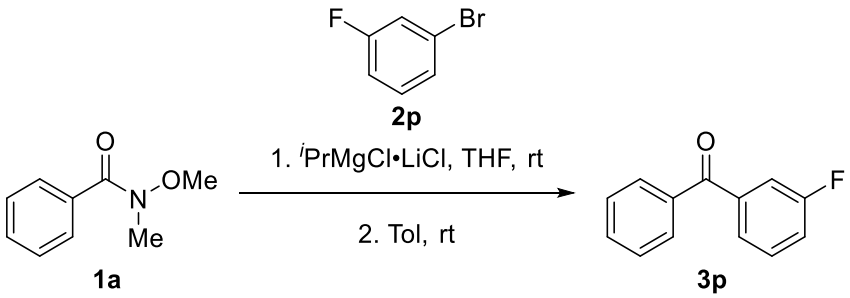
(m, 3H), 7.04 (d, J = 9.2 Hz, 1H), 3.77 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 196.52, 159.6, 138.92, 137.64, 132.45, 130.07, 129.24, 128.28, 122.88, 118.87, 114.3, 55.48.

Phenyl(3-(trifluoromethoxy)phenyl)methanone (**3o**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 2 days at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-(trifluoromethoxy)phenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 95% yield (25.3 mg). Oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.80 (d, J = 7.1 Hz, 2H), 7.73 (d, J = 7.7 Hz, 1H), 7.67 (s, 1H), 7.62 (t, J = 7.4 Hz, 1H), 7.55 – 7.49 (m, 3H), 7.45 (d, J = 8.2 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.01, 149.16 (q, J^F = 1.7 Hz), 139.47, 136.84, 132.94, 130.04, 129.87, 128.43 (d, J = 18.9 Hz), 124.74, 122.37, 120.44 (q, J^F = 258.0 Hz). ^{19}F NMR (471 MHz, $CDCl_3$) δ -57.88 (s).

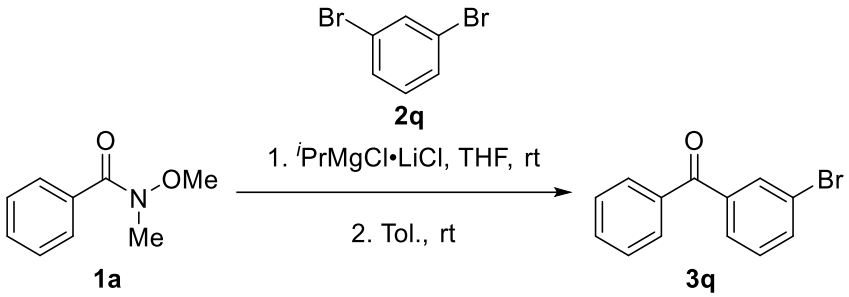
(3-Fluorophenyl)(phenyl)methanone (**3p**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-fluorophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and

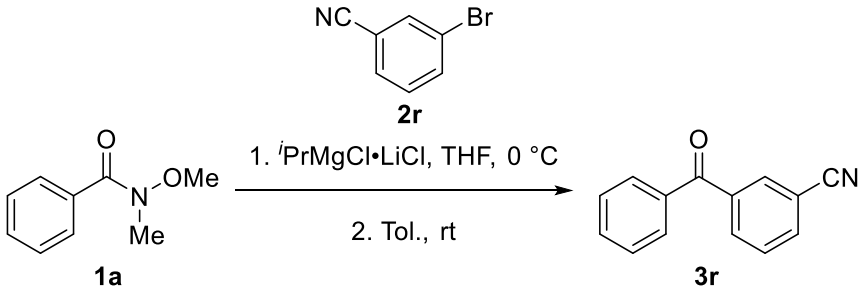
chromatography the title compound in 72% yield (14.4 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.82 (d, *J* = 7.5 Hz, 2H), 7.65 – 7.58 (m, 2H), 7.55 – 7.45 (m, 4H), 7.34 – 7.28 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.31 (d, J^F = 2.0 Hz), 162.51 (d, J^F = 248.1 Hz), 139.69 (d, J^F = 6.3 Hz), 137.05, 132.79, 130.03, 129.95, 128.44, 125.83 (d, J^F = 3.0 Hz), 119.44 (d, J^F = 21.4 Hz), 116.76 (d, J^F = 22.5 Hz). ^{19}F NMR (471 MHz, $CDCl_3$) δ -111.99.

(3-Bromophenyl)(phenyl)methanone (**3q**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-bromophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 85% yield (22.1 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.86 (s, 1H), 7.72 (d, *J* = 7.1 Hz, 2H), 7.64 (d, *J* = 7.9 Hz, 2H), 7.54 (t, *J* = 7.4 Hz, 1H), 7.43 (t, *J* = 7.7 Hz, 2H), 7.29 (t, *J* = 7.8 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.17, 139.50, 136.94, 135.29, 132.87, 132.81, 130.05, 129.89, 128.57, 128.49, 122.59.

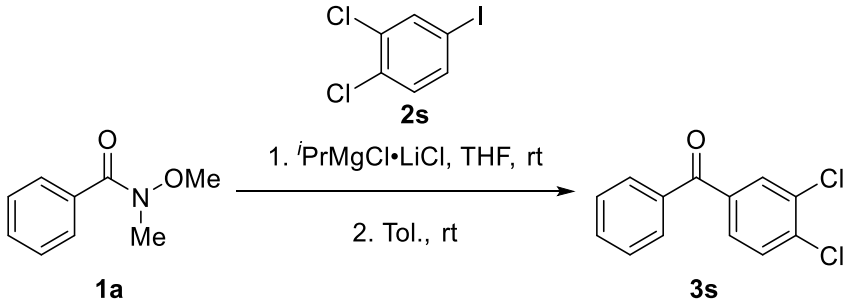
3-Benzoylbenzonitrile (**3r**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 h at 0 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-

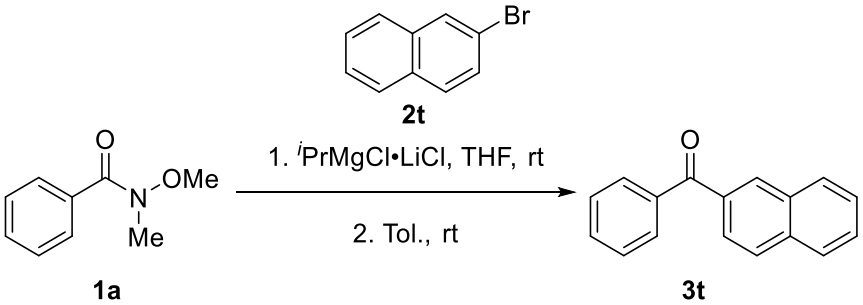
cyanophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 73% yield (15.1 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.07 (s, 1H), 8.04 (d, *J* = 7.8 Hz, 1H), 7.87 (d, *J* = 7.7 Hz, 1H), 7.78 (d, *J* = 7.8 Hz, 2H), 7.68 – 7.62 (m, 2H), 7.53 (t, *J* = 7.6 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.42, 138.64, 136.33, 135.37, 133.86, 133.49, 133.30, 130.02, 129.42, 128.70, 117.96, 112.87.

(3,4-Dichlorophenyl)(phenyl)methanone (**3s**, Scheme 1)



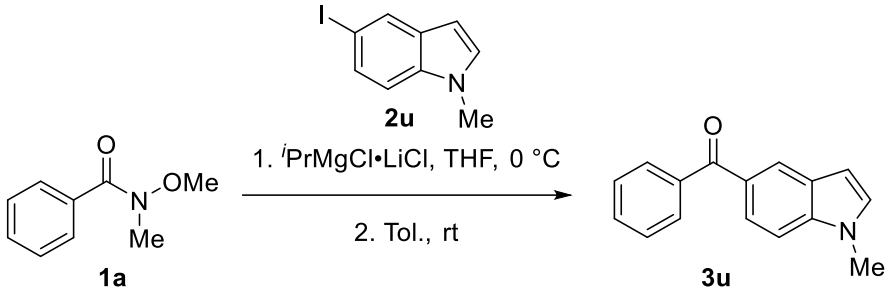
According to the general procedure, I/Mg exchange was completed after 2 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3,4-dichlorophenyl)magnesium chloride chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 90% yield (22.5 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.86 (d, *J* = 1.6 Hz, 1H), 7.74 (d, *J* = 7.2 Hz, 2H), 7.59 (t, *J* = 7.7 Hz, 2H), 7.54 (d, *J* = 8.3 Hz, 1H), 7.47 (t, *J* = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.25, 137.22, 137.05, 136.70, 133.01, 131.86, 130.48, 129.94, 129.10, 128.58.

Naphthalen-2-yl(phenyl)methanone (**3t**, Scheme 1)



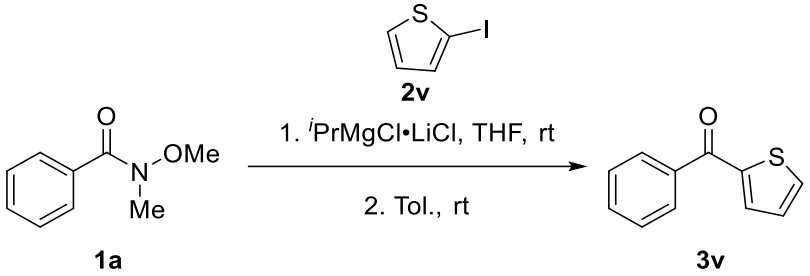
According to the general procedure, Br/Mg exchange was completed after 36 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared naphthalen-2-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 83% yield (19.3 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.29 (s, 1H), 7.99 – 7.87 (m, 6H), 7.67 – 7.61 (m, 2H), 7.60 - 7.52 (m, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 196.78, 137.93, 135.29, 134.85, 132.40, 132.28, 131.89, 130.12, 129.44, 128.37, 128.35, 128.32, 127.85, 126.82, 125.81.

(1-Methyl-1*H*-indol-5-yl)(phenyl)methanone (**3u**, Scheme 1)



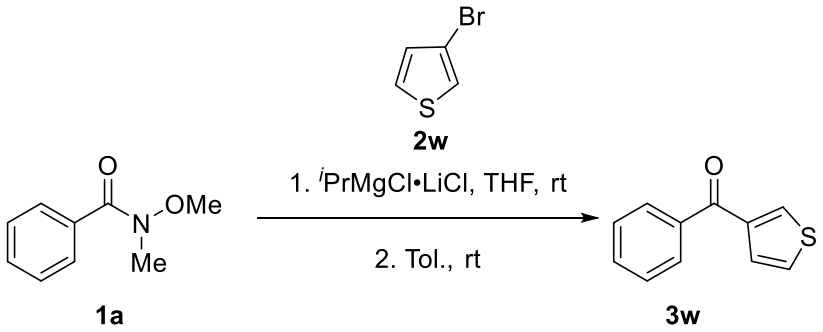
According to the general procedure, I/Mg exchange was completed after 1 h at 0 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (1-methyl-1*H*-indol-5-yl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 85% yield (20.0 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.02 (s, 1H), 7.75 – 7.69 (m, 3H), 7.47 (t, *J* = 7.4 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 2H), 7.28 (d, *J* = 8.6 Hz, 1H), 7.02 (d, *J* = 3.1 Hz, 1H), 6.48 (d, *J* = 2.8 Hz, 1H), 3.72 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 197.28, 139.17, 139.01, 131.57, 130.4, 129.91, 129.20, 128.11, 127.69, 125.49, 123.82, 109.1, 102.99, 33.09.

Phenyl(thiophen-2-yl)methanone (**3v**, Scheme 1)



According to the general procedure, I/Mg exchange was completed after 30 min at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared thiophen-2-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 93% yield (17.5 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 7.1 Hz, 2H), 7.72 (dd, *J* = 4.9, 1.0 Hz, 1H), 7.65 (dd, *J* = 3.7, 0.9 Hz, 1H), 7.59 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 2H), 7.16 (dd, *J* = 4.9, 3.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 188.26, 143.67, 138.18, 134.87, 134.23, 132.29, 129.19, 128.44, 127.98.

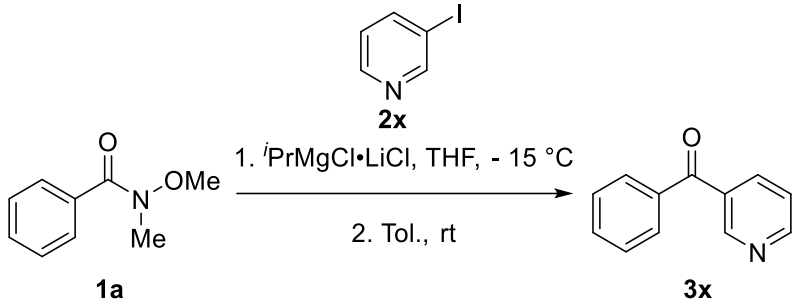
Phenyl(thiophen-3-yl)methanone (**3w**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 30 min at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared thiophen-3-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 92% yield (17.3 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.83 (dd, *J* = 2.9, 1.1 Hz, 1H), 7.75 (d, *J* = 7.1 Hz, 2H), 7.51 – 7.46 (m, 2H), 7.39 (t, *J*

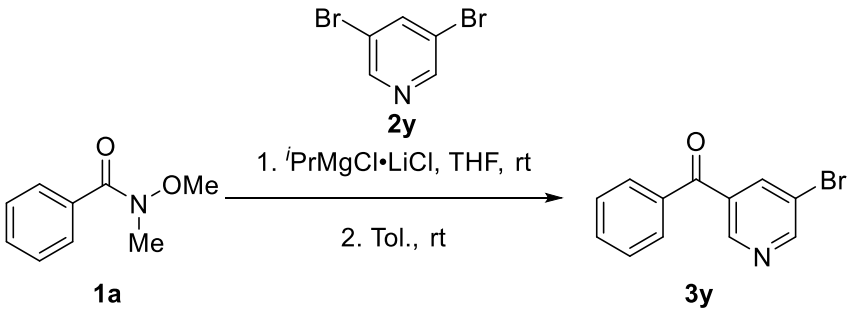
= 7.6 Hz, 2H), 7.29 – 7.27 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 190.00, 141.31, 138.64, 133.96, 132.34, 129.39, 128.62, 128.41, 126.26.

Phenyl(pyridin-3-yl)methanone (**3x**, Scheme 1)



According to the general procedure, I/Mg exchange was completed after 30 min at -15 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared pyridin-3-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 78% yield (14.3 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.99 (s, 1H), 8.79 – 8.20 (m, 1H), 8.11 (d, *J* = 7.9 Hz, 1H), 7.86 – 7.78 (m, 2H), 7.63 (t, *J* = 7.4 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H), 7.47 – 7.42 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.90, 152.87, 150.97, 137.19, 136.73, 133.19, 130.04, 128.64, 123.38.

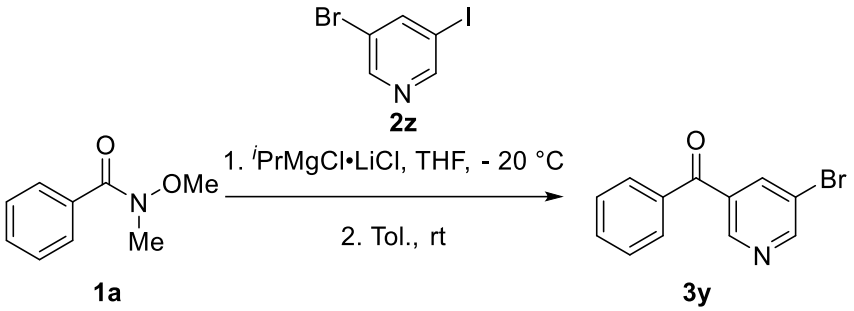
(5-Bromopyridin-3-yl)(phenyl)methanone (**3y**, Scheme 1)



According to the general procedure, Br/Mg exchange was completed after 3 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (5-bromopyridin-3-yl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and

chromatography the title compound in 65% yield (17.0 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.88 – 8.82 (m, 2H), 8.23 (t, *J* = 2.0 Hz, 1H), 7.83 – 7.76 (m, 2H), 7.64 (t, *J* = 7.4 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.33, 153.90, 148.82, 139.50, 136.24, 134.46, 133.58, 130.02, 128.81, 120.90.

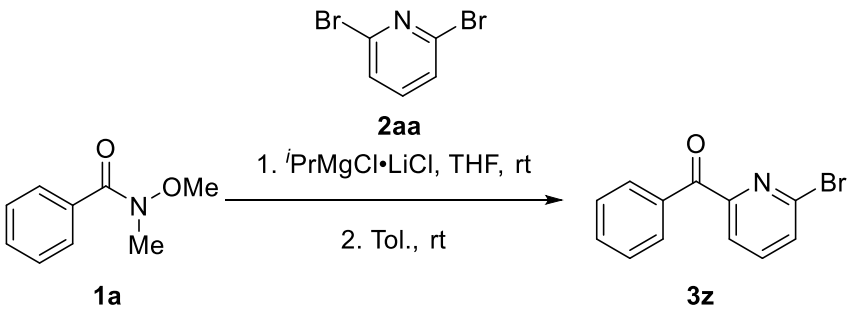
(5-Bromopyridin-3-yl)(phenyl)methanone (**3y**, Scheme 1)



1a **3y**

According to the general procedure, I/Mg exchange was completed after 50 min at -20 °C. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (5-bromopyridin-3-yl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 70% yield (18.3 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.88 – 8.82 (m, 2H), 8.23 (t, *J* = 2.0 Hz, 1H), 7.83 – 7.76 (m, 2H), 7.64 (t, *J* = 7.4 Hz, 1H), 7.51 (t, *J* = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.33, 153.90, 148.82, 139.50, 136.24, 134.46, 133.58, 130.02, 128.81, 120.90.

(6-Bromopyridin-2-yl)(phenyl)methanone (**3z**, Scheme 1)

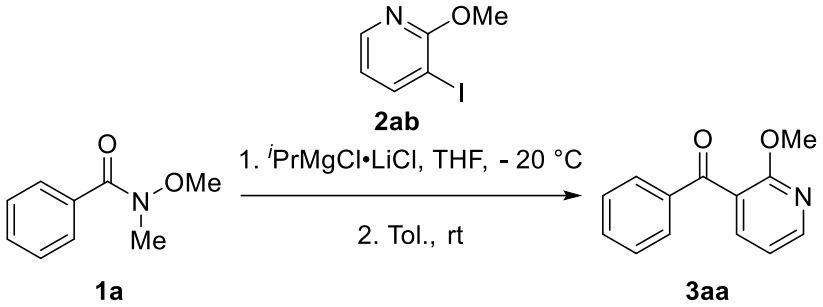


1a **3z**

According to the general procedure, Br/Mg exchange was completed after 3 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (6-

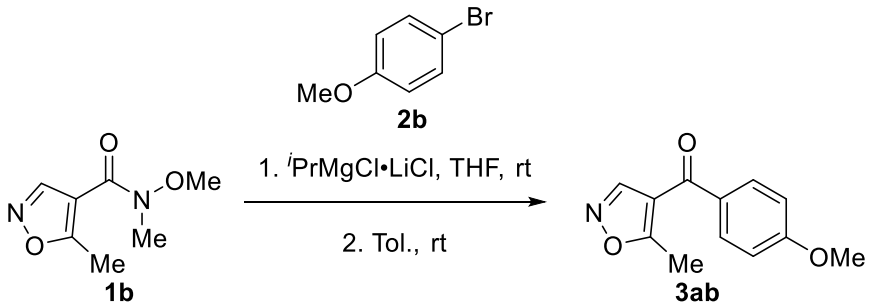
bromopyridin-2-yl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 79% yield (20.7 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.11 (d, *J* = 7.4 Hz, 2H), 7.98 (d, *J* = 7.5 Hz, 1H), 7.76 (t, *J* = 7.7 Hz, 1H), 7.68 (d, *J* = 7.9 Hz, 1H), 7.61 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.7 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 191.69, 155.80, 140.77, 139.31, 135.54, 133.34, 131.18, 130.86, 128.28, 123.49.

(3-Methoxypyridin-2-yl)(phenyl)methanone (**3aa**, Scheme 1)



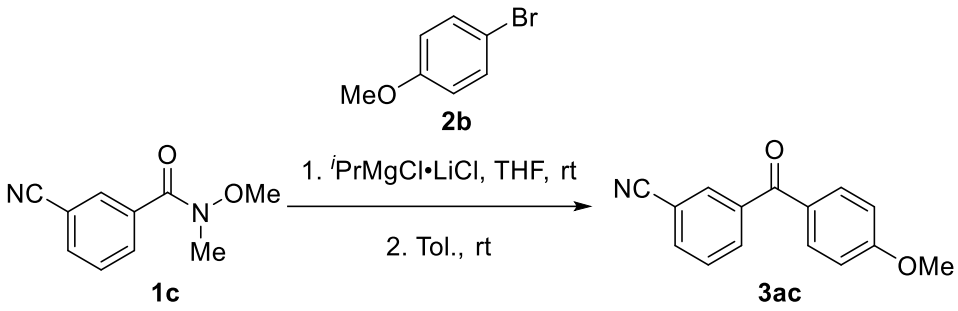
According to the general procedure, I/Mg exchange was completed after 15 h at rt. The reaction of *N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (2-meyhoxy-3-yl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 81% yield (17.3 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.32 (dd, *J* = 5.0, 1.8 Hz, 1H), 7.80 (d, *J* = 7.3 Hz, 2H), 7.72 (dd, *J* = 7.3, 1.9 Hz, 1H), 7.58 (t, *J* = 7.4 Hz, 1H), 7.45 (t, *J* = 7.7 Hz, 2H), 7.00 (dd, *J* = 7.2, 5.1 Hz, 1H), 3.88 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.78, 161.19, 149.2, 138.88, 137.20, 133.29, 129.75, 128.39, 122.68, 116.52, 53.65.

(4-Methoxyphenyl)(5-methylisoxazol-4-yl)methanone (**3ab**, Scheme 2)



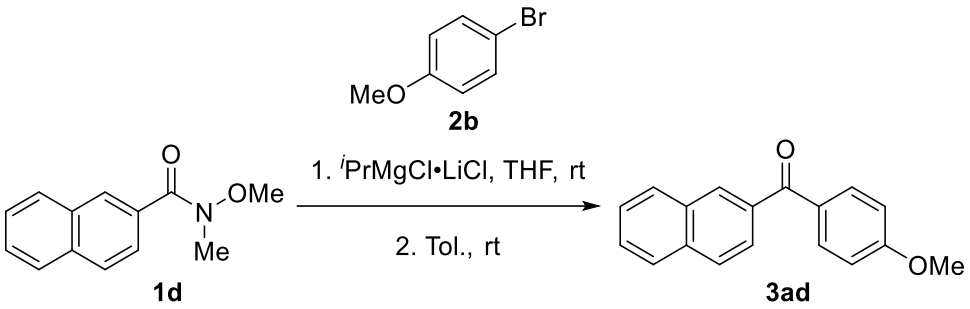
According to the general procedure, Br/Mg exchange was completed after 3 days at rt. The reaction of *N*-methoxy-*N*,2-dimethylfuran-3-carboxamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-methoxyphenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 68% yield (14.8 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.43 (s, 1H), 7.79 (d, *J* = 8.7 Hz, 2H), 6.99 (d, *J* = 8.7 Hz, 2H), 3.89 (s, 3H), 2.68 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 186.83, 174.21, 163.66, 150.36, 131.23, 130.81, 116.12, 114.05, 55.58, 12.95.

3-(4-Methoxybenzoyl)benzonitrile (**3ac**, Scheme 2)



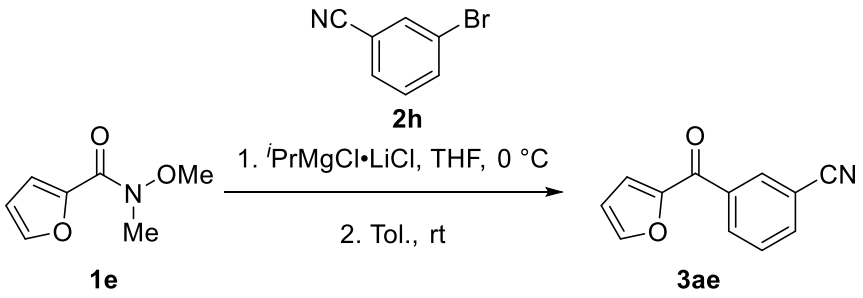
According to the general procedure, Br/Mg exchange was completed after 3 days at rt. The reaction of 3-cyano-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-methoxyphenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 80% yield (19.0 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.99 (s, 1H), 7.96 (d, *J* = 7.9 Hz, 1H), 7.82 (d, *J* = 7.8 Hz, 1H), 7.77 (d, *J* = 8.9 Hz, 2H), 7.59 (t, *J* = 7.8 Hz, 1H), 6.97 (d, *J* = 8.9 Hz, 2H), 3.88 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.11, 163.89, 139.39, 134.90, 133.60, 133.15, 132.59, 129.32, 128.94, 118.07, 113.99, 112.71, 55.63.

(4-Methoxyphenyl)(naphthalen-2-yl)methanone (**3ad**, Scheme 2)



According to the general procedure, Br/Mg exchange was completed after 3 days at rt. The reaction of *N*-methoxy-*N*-methyl-2-naphthamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-methoxyphenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 90% yield (23.6 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.23 (s, 1H), 7.96 – 7.86 (m, 6H), 7.64 – 7.53 (m, 2H), 7.00 (d, *J* = 8.8 Hz, 2H), 3.91 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 195.59, 163.24, 135.54, 135.05, 132.62, 132.30, 131.13, 130.46, 129.29, 128.20, 128.06, 127.84, 126.75, 125.92, 113.65, 55.55.

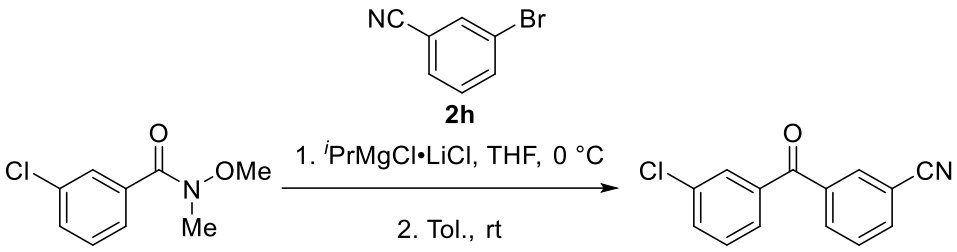
3-(Furan-2-carbonyl)benzonitrile (**3ae**, Scheme 2)



According to the general procedure, Br/Mg exchange was completed after 3 h at 0 °C. The reaction of *N*-methoxy-*N*-methylfuran-2-carboxamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-cyanophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 75% yield (14.8 mg). *New compound.* White solid. Mp = 102-103 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.33 (s, 1H), 8.24 (d, *J* = 7.9 Hz, 1H), 7.87 (d, *J* = 9.1 Hz, 1H), 7.79 – 7.73 (m, 1H), 7.65 (t, *J* = 7.8 Hz, 1H), 7.35 (d, *J* = 3.6 Hz, 1H), 6.66 (dd, *J* = 3.6, 1.7 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 179.86, 151.92, 147.68, 137.96, 135.55,

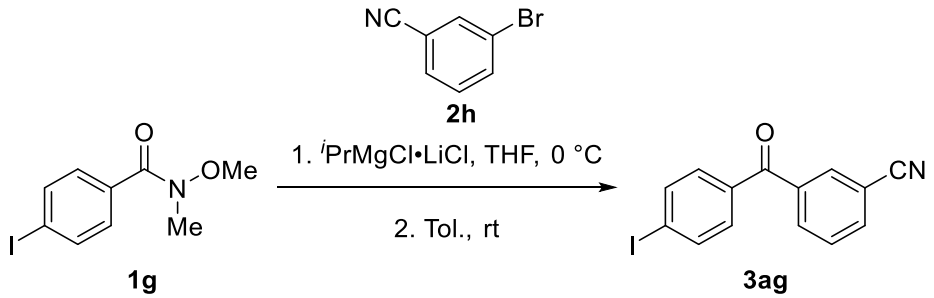
133.41, 133.07, 129.51, 121.14, 118.02, 112.95, 112.77. HRMS calcd for $C_{12}H_8NO_2$ (M + H) 198.0550, found 198.0549.

3-(3-Chlorobenzoyl)benzonitrile (**3af**, Scheme 2)



According to the general procedure, Br/Mg exchange was completed after 3 h at 0 °C. The reaction of methyl 3-chloro-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-cyanophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 70% yield (16.9 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.09 (s, 1H), 8.05 (d, *J* = 7.9 Hz, 1H), 7.92 (d, *J* = 7.7 Hz, 1H), 7.79 (s, 1H), 7.70 – 7.63 (m, 3H), 7.50 (t, *J* = 7.9 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.03, 138.01, 137.95, 135.74, 135.11, 133.78, 133.38, 133.25, 130.02, 129.83, 129.59, 128.05, 117.80, 113.14.

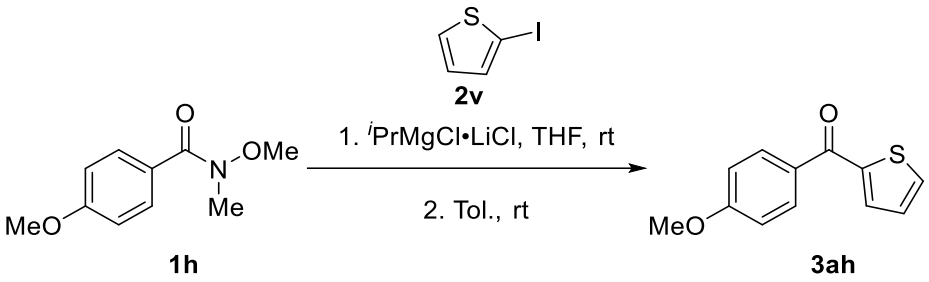
3-(4-Iodobenzoyl)benzonitrile (**3ag**, Scheme 2)



According to the general procedure, I/Mg exchange was completed after 3h at 0 °C. The reaction of *4*-iodo-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-cyanophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 65% yield (21.6 mg). *New compound.* White solid. Mp =

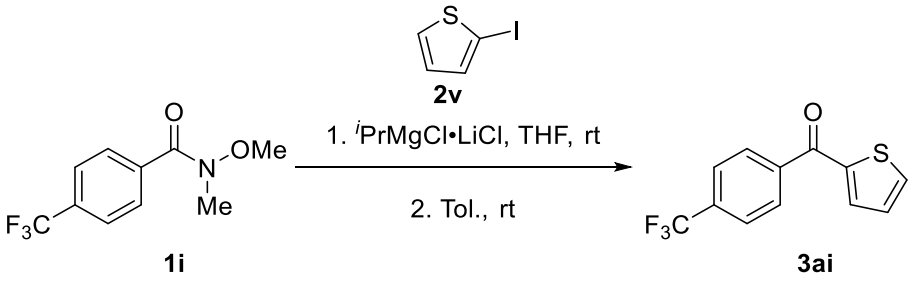
149-150 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.97 (s, 1H), 7.93 (d, *J* = 7.9 Hz, 1H), 7.82 (t, *J* = 7.7 Hz, 3H), 7.57 (t, *J* = 7.8 Hz, 1H), 7.42 (d, *J* = 8.5 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.64, 138.17, 138.05, 135.60, 135.58, 133.72, 133.33, 131.30, 129.54, 117.81, 113.07, 101.30. HRMS calcd for $C_{14}H_9INO$ (M + H) 333.9723, found 333.9722.

(4-Methoxyphenyl)(thiophen-2-yl)methanone (**3ah**, Scheme 2)



According to the general procedure, I/Mg exchange was completed after 30 min at rt. The reaction of *N*,4-dimethoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared thiophen-2-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 96% yield (20.9 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.91 (d, *J* = 8.2 Hz, 2H), 7.69 (d, *J* = 4.9 Hz, 1H), 7.65 (d, *J* = 3.7 Hz, 1H), 7.16 (t, *J* = 4.3 Hz, 1H), 6.99 (d, *J* = 8.3 Hz, 2H), 3.90 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 186.89, 163.12, 143.87, 134.01, 133.43, 131.64, 130.73, 127.77, 113.71, 55.52.

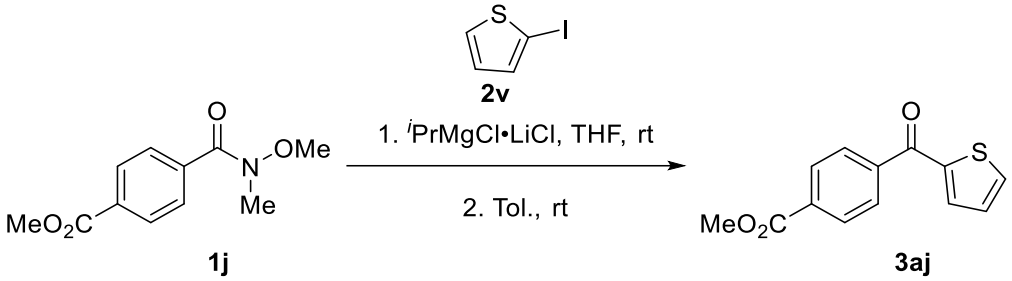
Thiophen-2-yl(4-(trifluoromethyl)phenyl)methanone (**3ai**, Scheme 2)



According to the general procedure, I/Mg exchange was completed after 30 min at rt. The reaction of *N*-methoxy-*N*-methyl-*4*-(trifluoromethyl)benzamide (0.10 mmol, 1.0 equiv) and freshly prepared thiophen-2-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in

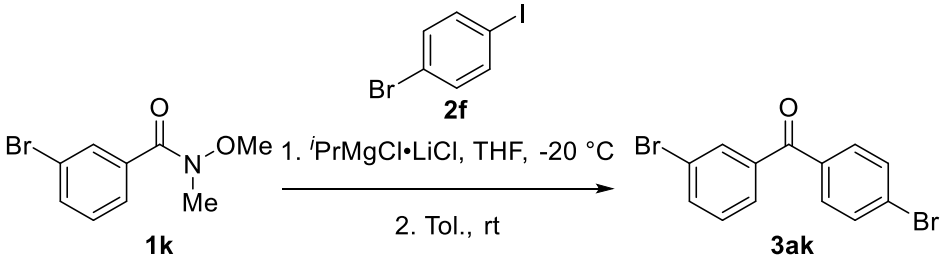
toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 97% yield (24.8 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.98 (d, *J* = 8.0 Hz, 2H), 7.85 – 7.75 (m, 3H), 7.65 (dd, *J* = 3.8, 1.0 Hz, 1H), 7.24 – 7.20 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 187.07, 143.01, 141.22, 135.29, 135.16, 133.57, 132.36 (q, J^F = 33.2 Hz), 128.25, 125.51 (q, J^F = 3.7 Hz), 123.66 (q, J^F = 272.4 Hz. ^{19}F NMR (471 MHz, $CDCl_3$) δ -62.99 (s).

Methyl 4-(thiophene-2-carbonyl)benzoate (**3aj**, Scheme 2)



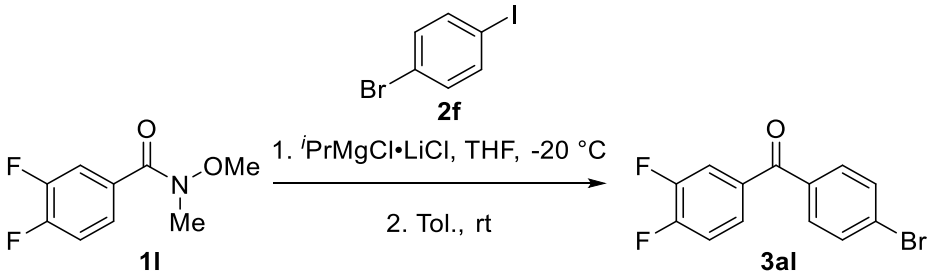
According to the general procedure, I/Mg exchange was completed after 30 min at rt. The reaction of methyl 4-(methoxy(methyl)carbamoyl)benzoate (0.10 mmol, 1.0 equiv) and freshly prepared thiophen-2-ylmagnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 72% yield (17.7 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.16 (d, *J* = 8.3 Hz, 2H), 7.90 (d, *J* = 8.3 Hz, 2H), 7.76 (d, *J* = 4.9 Hz, 1H), 7.63 (d, *J* = 2.8 Hz, 1H), 7.20 – 7.17 (m, 1H), 3.97 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 187.56, 166.29, 143.24, 141.84, 135.22, 134.96, 133.19, 129.67, 128.99, 128.20, 52.50.

(3-Bromophenyl)(4-bromophenyl)methanone (**3ak**, Scheme 2)



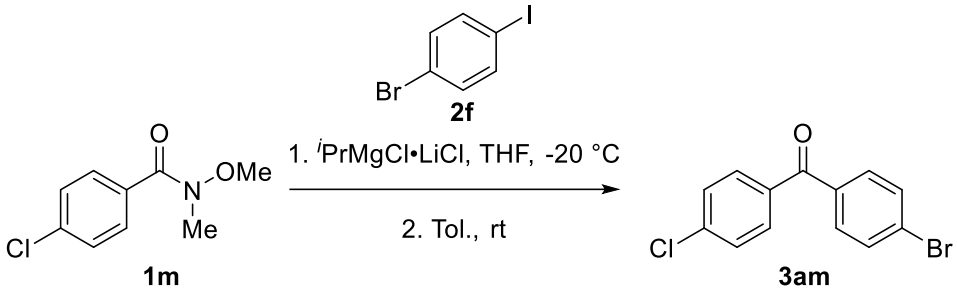
According to the general procedure, I/Mg exchange was completed after 3 h at -20 °C. The reaction of 3-bromo-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-bromophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 79% yield (26.9 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.89 (s, 1H), 7.72 (d, *J* = 7.1 Hz, 1H), 7.70 – 7.61 (m, 5H), 7.36 (t, *J* = 7.8 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.10, 139.05, 135.64, 135.55, 132.71, 131.85, 131.51, 130.02, 128.42, 128.07, 122.73.

(4-Bromophenyl)(3,4-difluorophenyl)methanone (**3al**, Scheme 2)



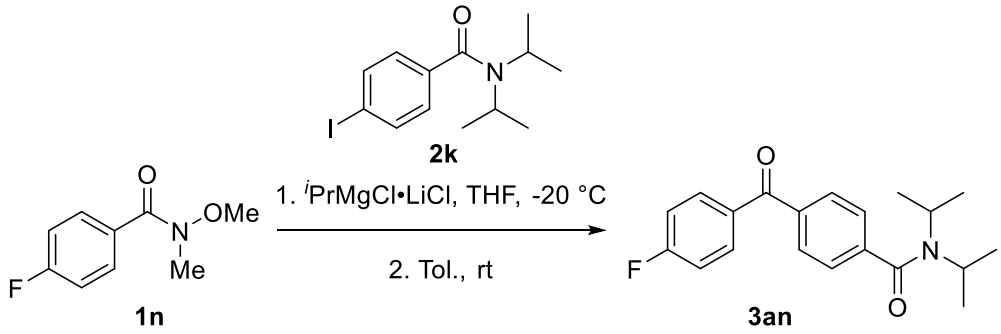
According to the general procedure, I/Mg exchange was completed after 3 h at -20 °C. The reaction of 3,4-difluoro-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-bromophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 94% yield (27.9 mg). White solid. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.61 – 7.54 (m, 5H), 7.51 – 7.46 (m, 1H), 7.22 (dd, *J* = 9.2, 8.1 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.00, 153.40 (q, J^F = 257.0, 12.9 Hz), 150.25 (q, J^F = 251.6 Hz), 135.59, 134.56 (q, J^F = 4.3 Hz), 133.52 (m), 131.88, 131.34, 127.99, 127.01 (q, J^F = 3.7 Hz), 119.26 (q, *J* = 18.2 Hz), 117.45 (d, J^F = 17.8 Hz). ^{19}F NMR (471 MHz, $CDCl_3$) δ -129.92, -135.78.

(4-Bromophenyl)(4-chlorophenyl)methanone (**3am**, Scheme 2)



According to the general procedure, I/Mg exchange was completed after 3 h at -20 °C. The reaction of 4-chloro-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-bromophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 70% yield (20.7 mg). ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.73 (d, *J* = 8.4 Hz, 2H), 7.64 (s, 4H), 7.47 (d, *J* = 8.5 Hz, 2H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.40, 139.22, 135.97, 135.46, 131.77, 131.43, 131.45, 128.80, 127.80.

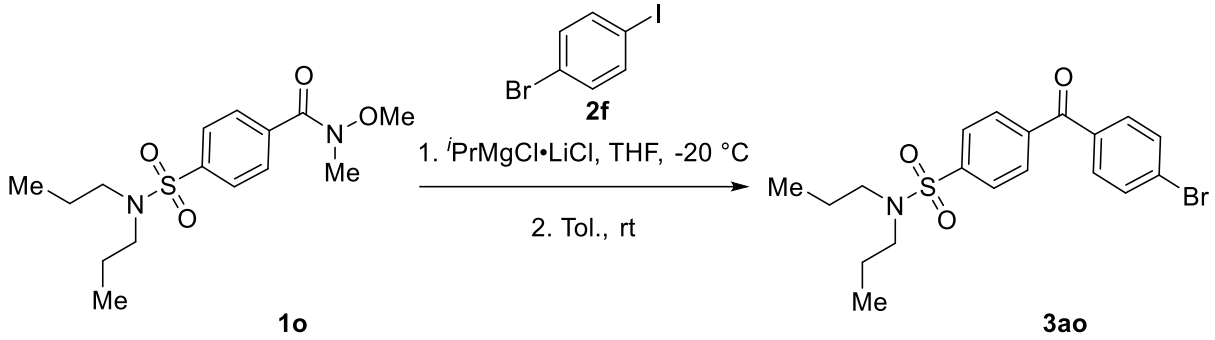
4-(4-Fluorobenzoyl)-*N,N*-diisopropylbenzamide (**3an**, Scheme 3)



According to the general procedure, I/Mg exchange was completed after 1 h at -20 °C. The reaction of 4-fluoro-*N*-methoxy-*N*-methylbenzamide (5.46 mmol, 1.0 equiv) and freshly prepared 4-*N,N*-diisopropylbenzamidemagnesium chloride/lithium chloride (6.55 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 78% yield (1.39 g). *New compound.* White solid. Mp = 109-110 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.81 – 7.75 (m, 2H), 7.71 (d, *J* = 8.3 Hz, 2H), 7.35 (d, *J* = 8.3 Hz, 2H), 7.13 – 7.07 (m, 2H), 3.60 (d, *J* = 127.6 Hz, 2H), 1.29 (d, *J* = 198.2 Hz, 12H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.68, 169.84, 165.54 (d, J^F = 254.7 Hz),

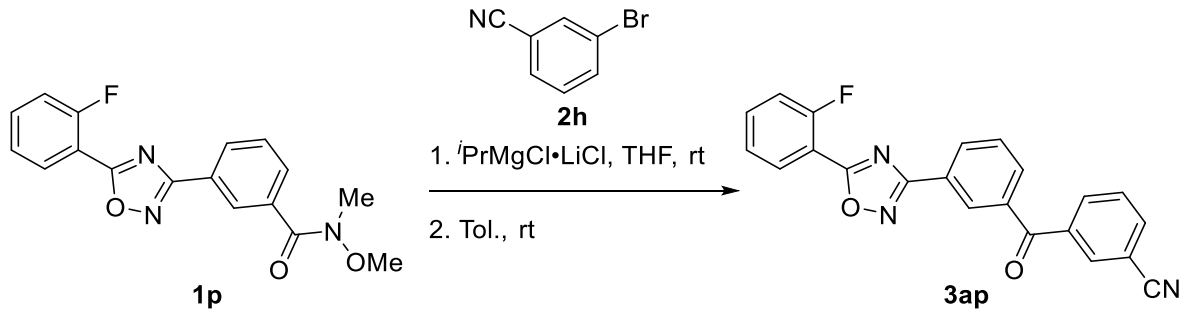
142.69, 137.59, 133.48 (d, J^F = 3.0 Hz), 132.72 (d, J^F = 9.3 Hz), 130.14, 125.61, 115.61 (d, J^F = 21.9 Hz), 51.04, 46.03, 20.69. ^{19}F NMR (471 MHz, $CDCl_3$) δ -105.42. HRMS calcd for $C_{20}H_{23}FNO_2$ (M + H) 328.1707, found 328.1704.

4-(4-Bromobenzoyl)-*N*,*N*-dipropylbenzenesulfonamide (**3ao**, Scheme 4)



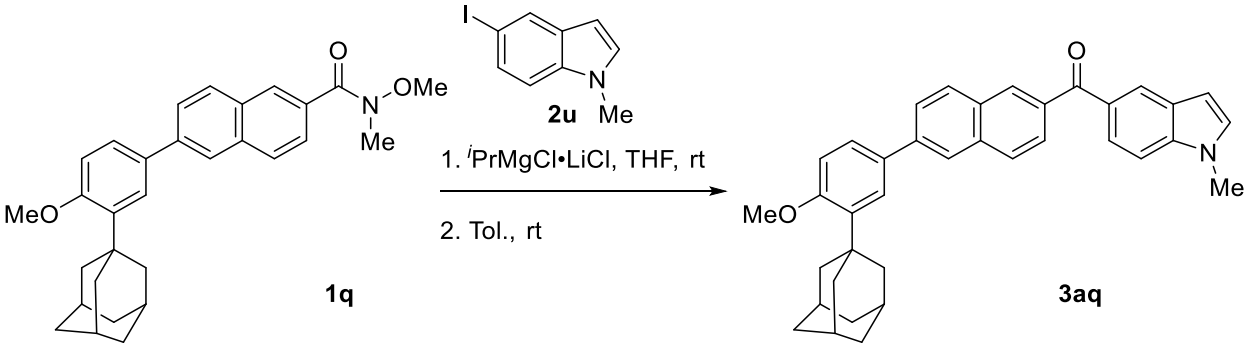
According to the general procedure, I/Mg exchange was completed after 3 h at -20 °C. The reaction of 4-(*N*,*N*-dipropylsulfamoyl)-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (4-bromophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 65% yield (27.5 mg). <u>*New compound.*</u> White solid. Mp = 70-71 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.2 Hz, 2H), 7.86 (d, *J* = 8.3 Hz, 2H), 7.66 (s, 4H), 3.15 – 3.10 (m, 4H), 1.62 – 1.54 (m, 4H), 0.88 (t, *J* = 7.4 Hz, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 194.37, 143.86, 140.33, 135.35, 131.97, 131.56, 130.27, 128.47, 127.09, 50.05, 22.05, 11.19. HRMS calcd for $C_{19}H_{23}BrNO_3S$ (M + H) 424.0577, found 424.0574.

3-(3-(5-(2-Fluorophenyl)-1,2,4-oxadiazol-3-yl)benzoyl)benzonitrile (**3ap**, Scheme 4)



According to the general procedure, Br/Mg exchange was completed after 3 h at 0 °C. The reaction of 3-(5-(2-fluorophenyl)-1,2,4-oxadiazol-3-yl)-*N*-methoxy-*N*-methylbenzamide (0.10 mmol, 1.0 equiv) and freshly prepared (3-cyanophenyl)magnesium chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 70% yield (25.9 mg). <u>*New compound.*</u> Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.59 (s, 1H), 8.50 (d, *J* = 7.8 Hz, 1H), 8.25 (t, *J* = 7.3 Hz, 1H), 8.16 (s, 1H), 8.11 (d, *J* = 7.9 Hz, 1H), 7.97 (d, *J* = 7.7 Hz, 1H), 7.94 (d, *J* = 7.7 Hz, 1H), 7.75 – 7.64 (m, 3H), 7.39 (t, *J* = 7.6 Hz, 1H), 7.32 (d, *J* = 9.0 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 193.65, 173.25 (d, *J* = 4.6 Hz), 167.87, 160.84 (d, *J* = 261.0 Hz), 138.23, 137.16, 135.72, 134.87 (d, *J* = 8.7 Hz), 133.87, 133.48, 132.37, 131.99, 130.99, 129.58, 129.46, 128.89, 127.59, 124.79 (d, *J* = 3.7 Hz), 117.86, 117.25 (d, *J* = 20.8 Hz), 113.18, 112.63 (d, *J* = 11.3 Hz). ^{19}F NMR (471 MHz, CDCl3) δ -108.10. HRMS calcd for $C_{22}H_{13}FN_3O_2$ (M + H) 370.0986, found 370.0986.

3-(3-(5-(2-Fluorophenyl)-1,2,4-oxadiazol-3-yl)benzoyl)benzonitrile (**3aq**, Scheme 4)



According to the general procedure, I/Mg exchange was completed after 3 h at 0 ºC. The reaction of 6-(3-(adamantan-1-yl)-4-methoxyphenyl)-*N*-methoxy-*N*-methyl-2-naphthamide (0.10 mmol, 1.0 equiv) and freshly prepared 1-methyl-1*H*-indole chloride/lithium chloride (0.12 mmol, 1.2 equiv) in toluene (0.25 M) at room temperature for 3 h, afforded after the standard work-up as described above and chromatography the title compound in 82% yield (43.0 mg). <u>*New compound.*</u> Colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.30 (s, 1H), 8.20 (s, 1H), 8.07 (s, 1H), 7.99 – 7.96 (m, 3H), 7.89 (dd, *J* = 8.6, 1.4 Hz, 1H), 7.81 (dd, *J* = 8.5, 1.6 Hz, 1H), 7.63 (d, *J* = 2.2 Hz, 1H), 7.58 (dd, *J* = 8.4, 2.2 Hz, 1H), 7.44 (d, *J* = 8.6 Hz, 1H), 7.17 (d, *J* = 3.1 Hz, 1H), 7.02 (d, *J* = 8.4 Hz, 1H), 6.62 (d, *J* = 2.9 Hz, 1H), 3.92 (s, 3H), 3.89 (s, 3H), 2.21 (s, 6H), 2.12 (s,

3H), 1.82 (s, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 197.24, 158.90, 141.02, 139.03, 138.98, 135.92, 135.38, 132.74, 131.08, 131.07, 130.40, 129.65, 128.10, 127.72, 126.61, 126.44, 126.00, 125.73, 125.40, 124.81, 123.93, 112.15, 109.13, 103.01, 55.20, 40.65, 37.24, 37.16, 33.11, 29.14. HRMS calcd for $C_{37}H_{36}NO_2$ (M + H) 526.2741, found 526.2739.

Mechanistic Studies

Selectivity Studies: Electrophiles. According to the general procedure, an oven-dried vial equipped with a stir bar was charged with two amide substrates (each 0.10 mmol, 1.0 equiv). Toluene and a freshly prepared solution of organomagnesium reagent (0.10 mmol, 1.0 equiv) were sequentially added with vigorous stirring, and the reaction mixture was stirred for 3 h at room temperature. After the indicated time, the reaction mixture was quenched with NH_4Cl (aq., sat., 1.0 mL) and diluted with ethyl acetate (10 mL). The organic layer was washed with water (1 x 10 mL), brine (1 x 10 mL), dried, and concentrated. A sample was analyzed by ^1H NMR ($CDCl_3$, 500 MHz) and GC-MS to obtain conversion, yield and selectivity using internal standard and comparison with authentic samples. The observed selectivity is consistent with the relative electrophilicity of the amide bond.

Selectivity Studies: Grignard Reagents. According to the general procedure, an oven-dried vial equipped with a stir bar was charged with an amide substrate (0.10 mmol, 1.0 equiv). Toluene and a freshly prepared solution of two organomagnesium reagents (each 0.10 mmol, 1.0 equiv) were added with vigorous stirring, and the reaction mixture was stirred at for 3 h room temperature. After the indicated time, the reaction mixture was quenched with NH_4Cl (aq., sat., 1.0 mL) and diluted with ethyl acetate (10 mL). The organic layer was washed with water (1 x 10 mL), brine (1 x 10 mL), dried, and concentrated. A sample was analyzed by ^1H NMR ($CDCl_3$, 500 MHz) and GC-MS to obtain conversion, yield and selectivity using internal standard and comparison with authentic samples. The observed selectivity is consistent with nucleophilic addition to the amide bond.

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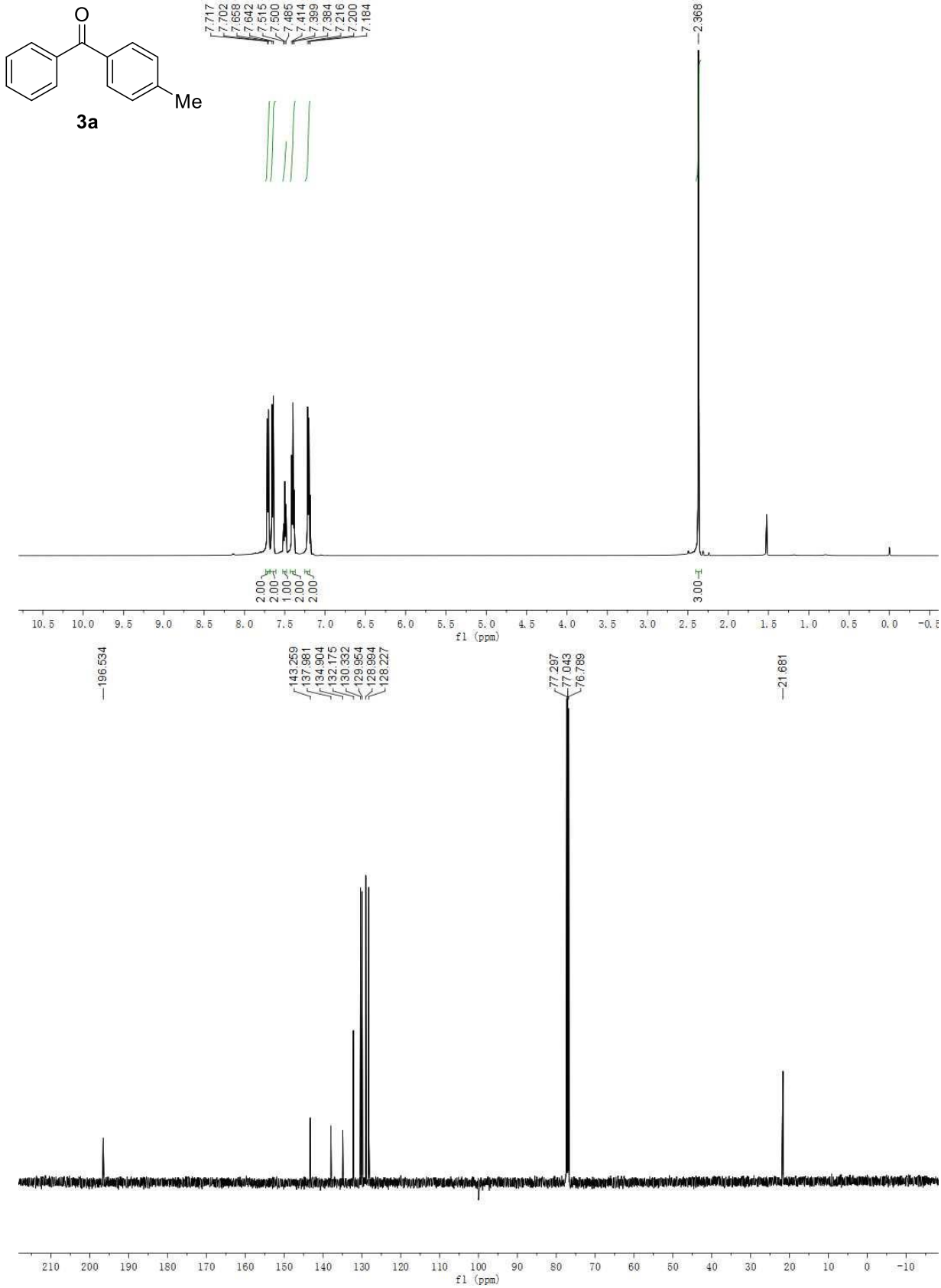
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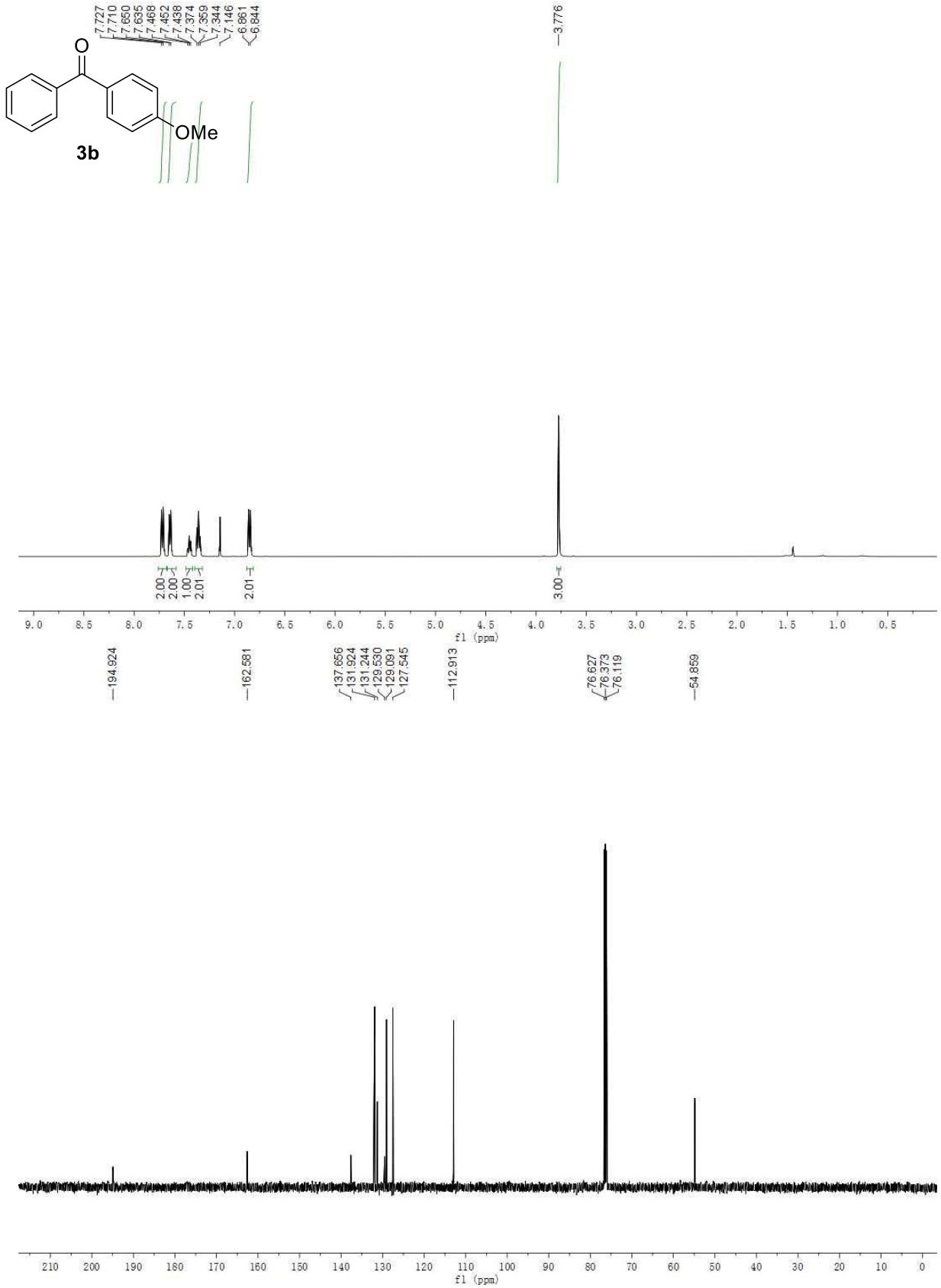
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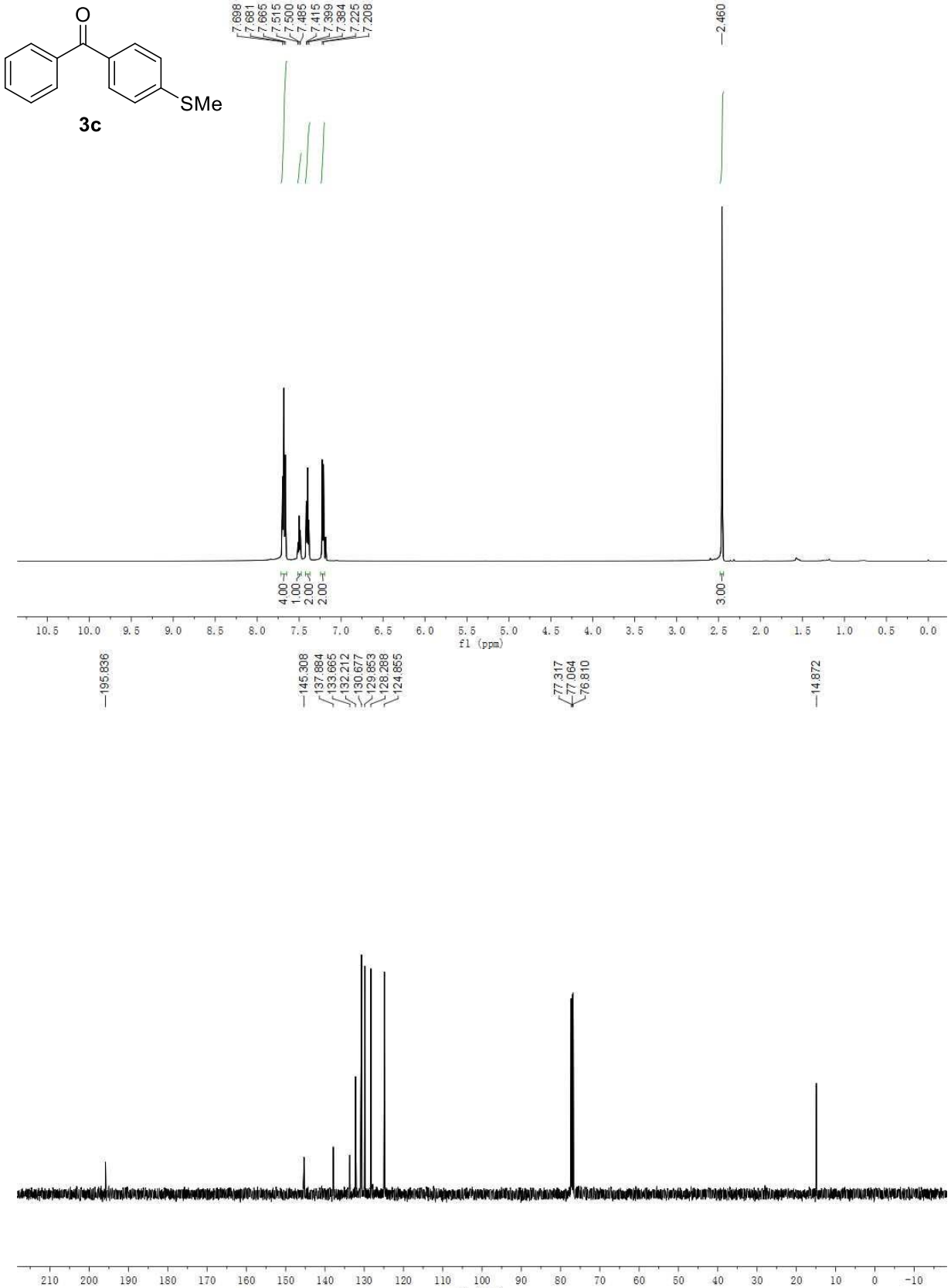
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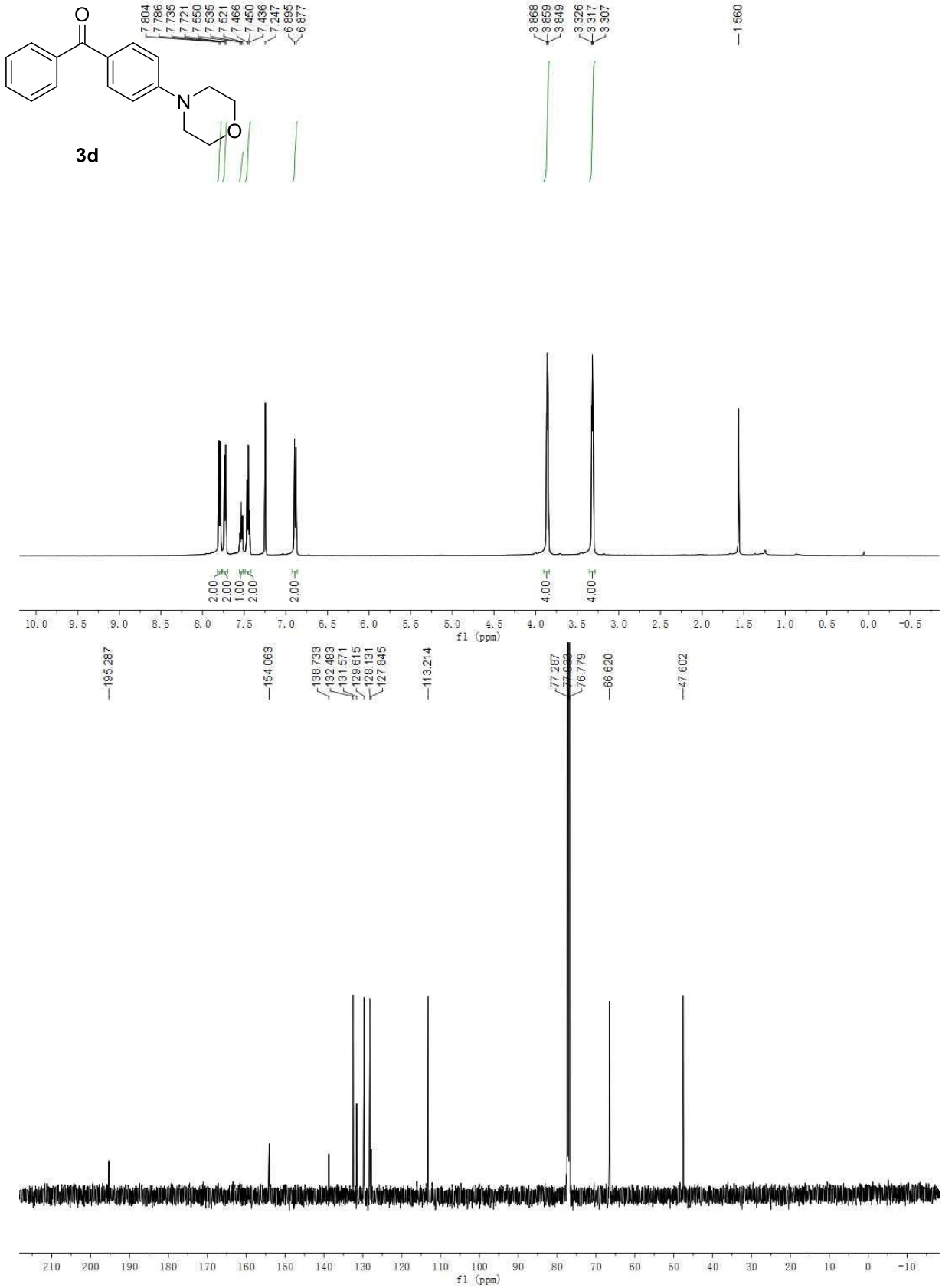
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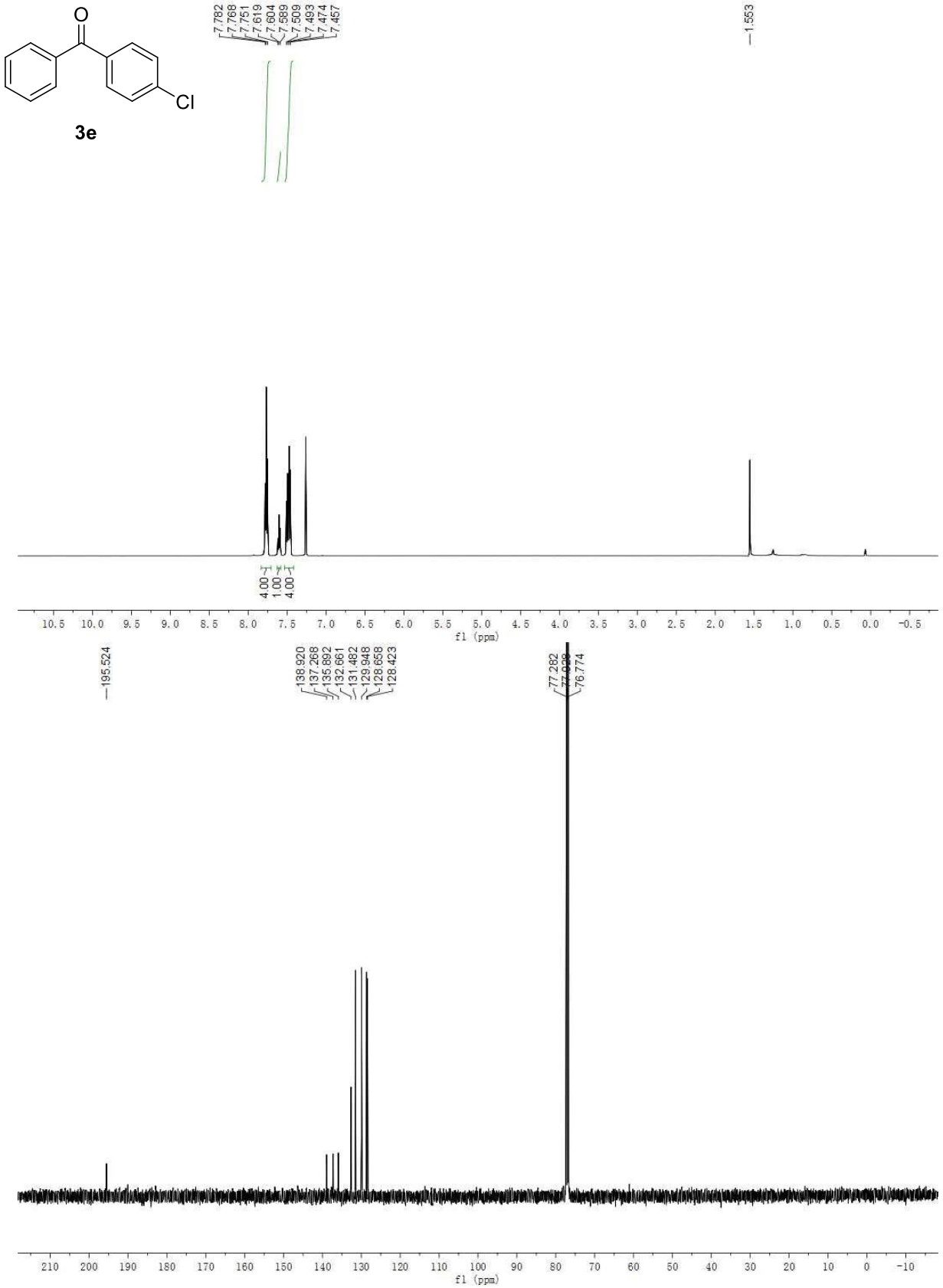
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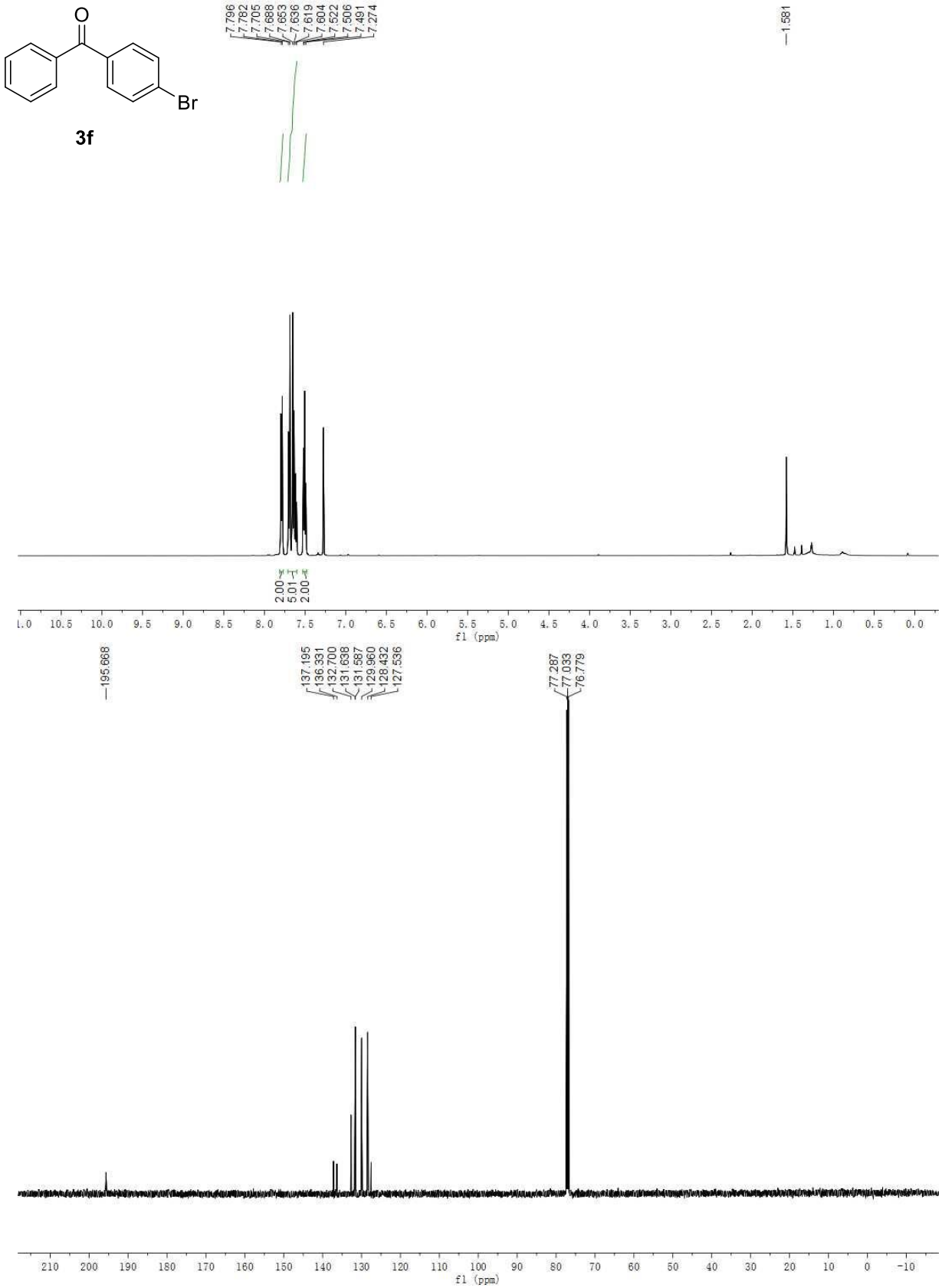
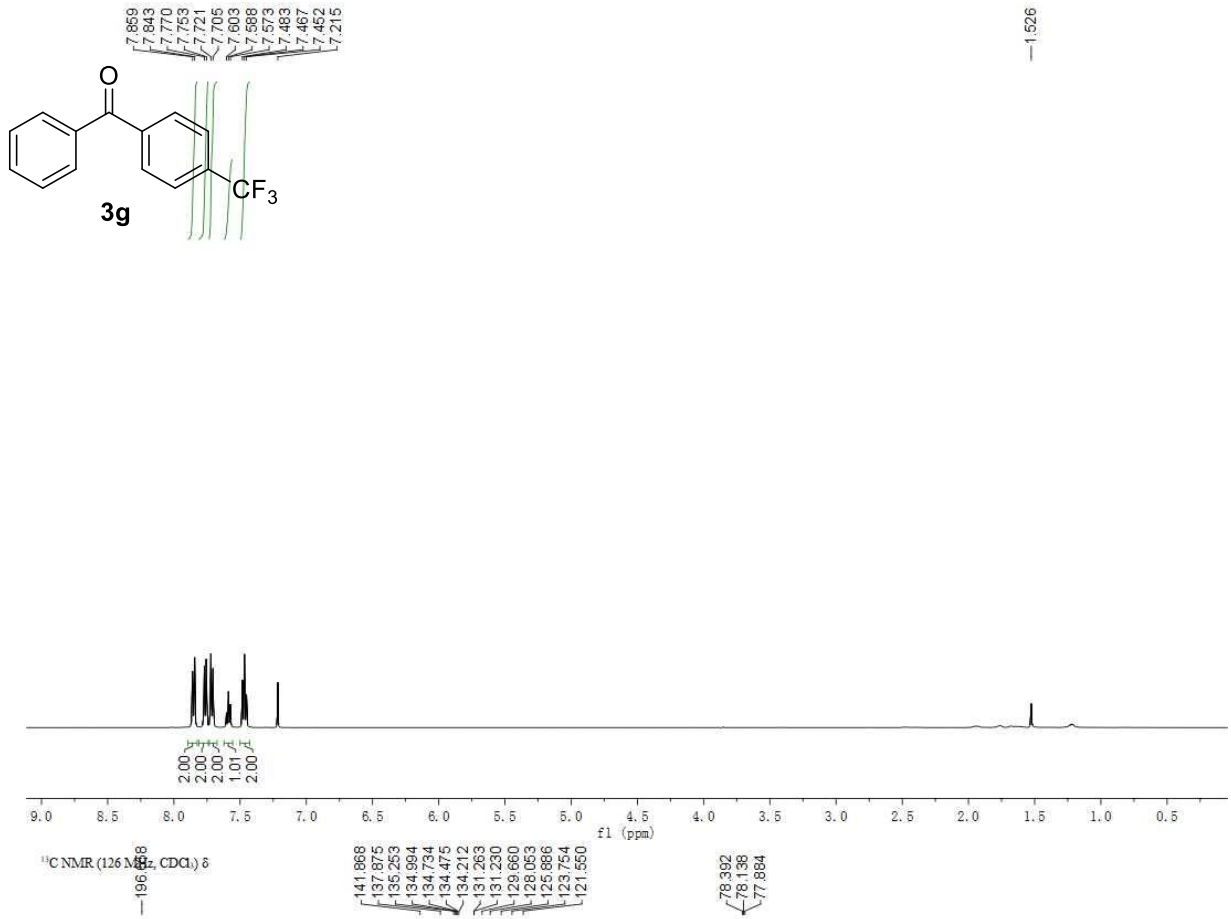
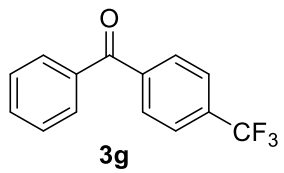
4.00
1.00
4.00
f1 (ppm)
195.524
138.920
137.268
135.892
132.661
131.482
129.948
128.658
128.423
77.282
77.028
76.774
f1 (ppm)

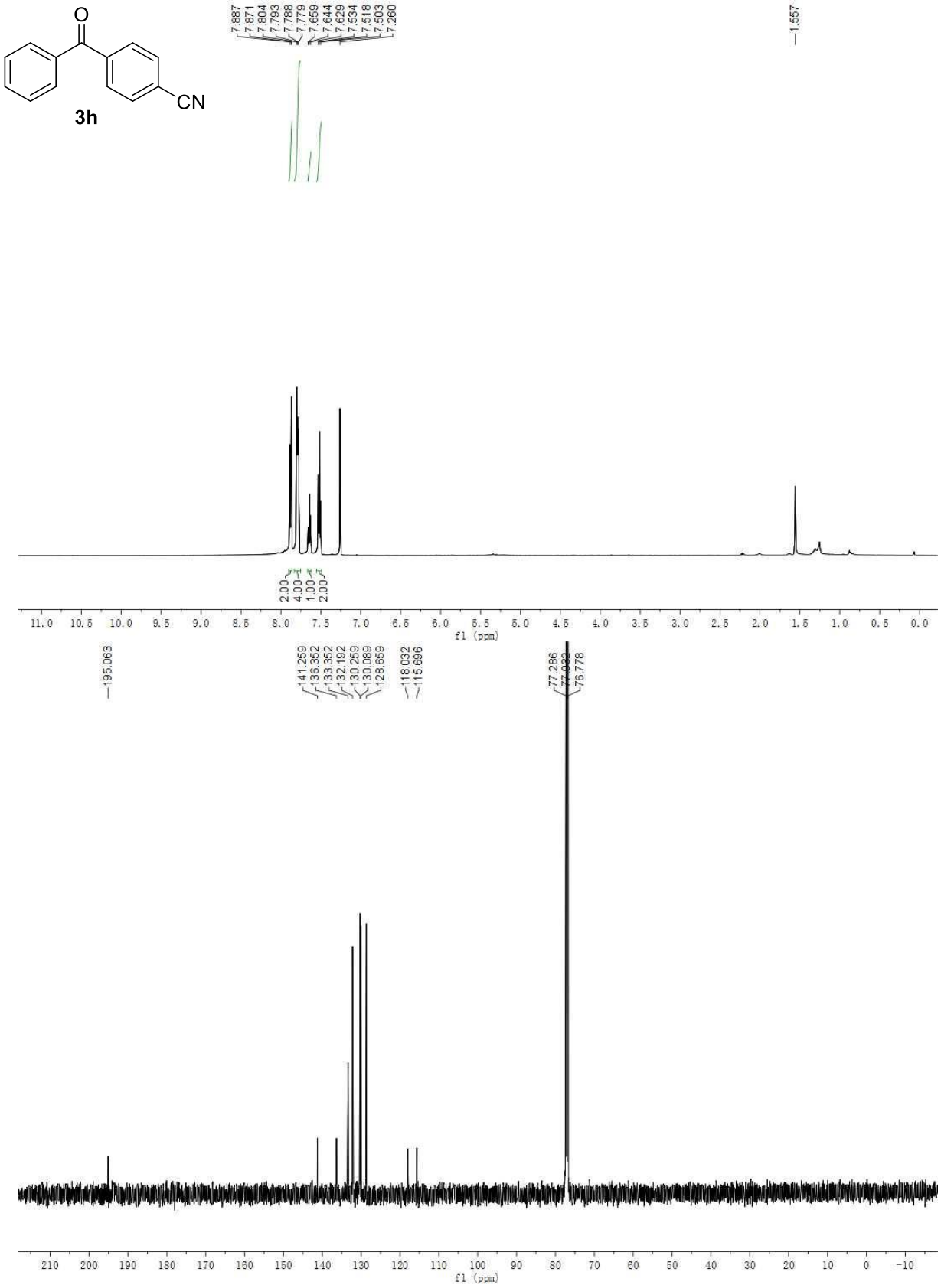

O
Br
3f
7.796
7.782
7.705
7.688
7.653
7.636
7.619
7.604
7.522
7.506
7.491
7.274
1.581
2.00
5.01
2.00
f1 (ppm)
195.668
137.195
136.331
132.700
131.638
131.587
129.960
128.432
127.536
77.287
77.033
76.779
f1 (ppm)

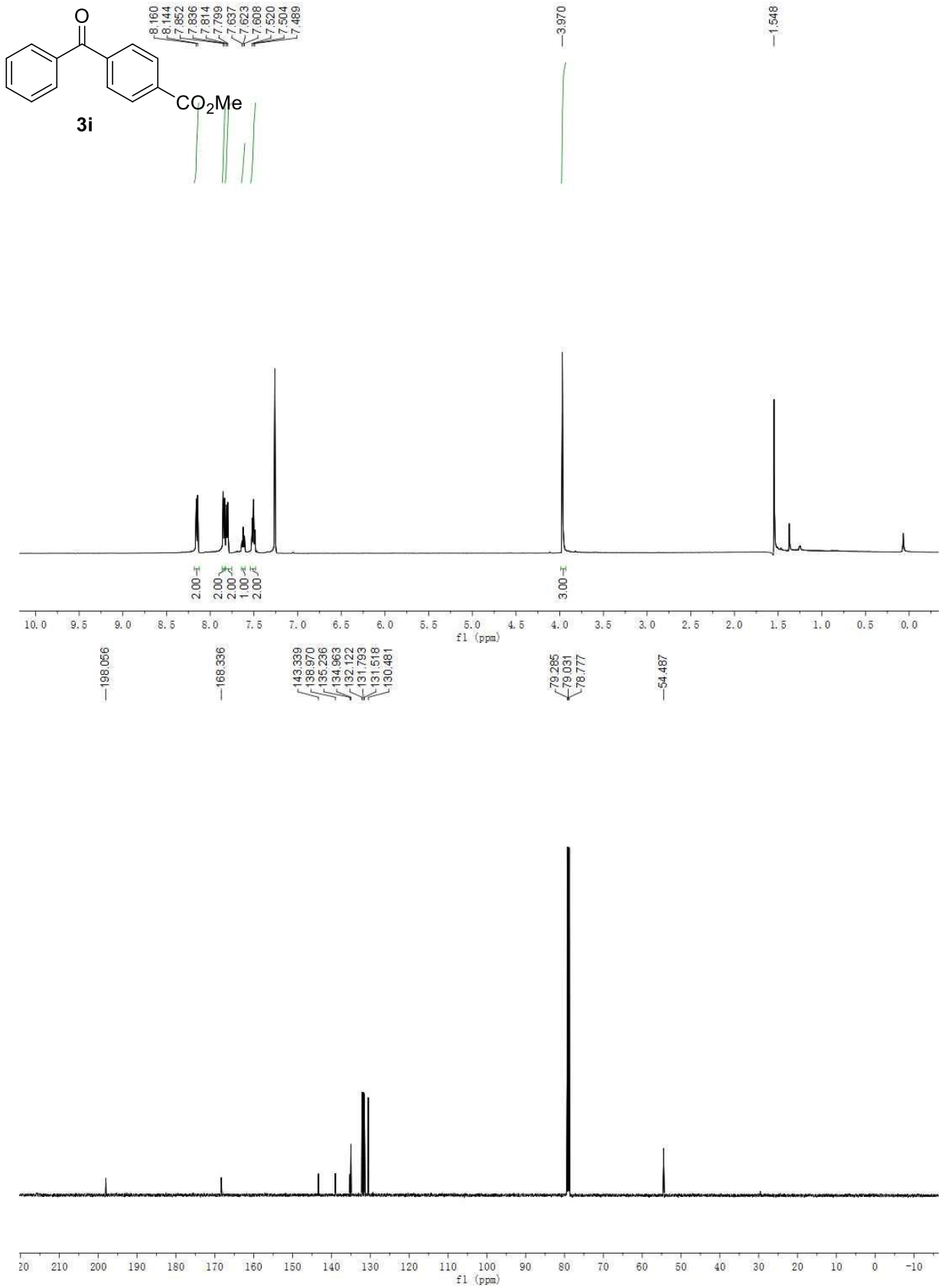

7.859
7.843
7.770
7.753
7.721
7.705
7.603
7.588
7.573
7.483
7.467
7.452
7.215
1.526
O
CF3
3g
2.00
2.00
2.00
1.01
2.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)
13C NMR (126 MHz, CDCl3) δ
196.688
141.868
137.875
135.253
134.994
134.734
134.475
134.212
131.263
131.230
129.660
128.053
125.886
123.754
121.550
78.392
78.138
77.884
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

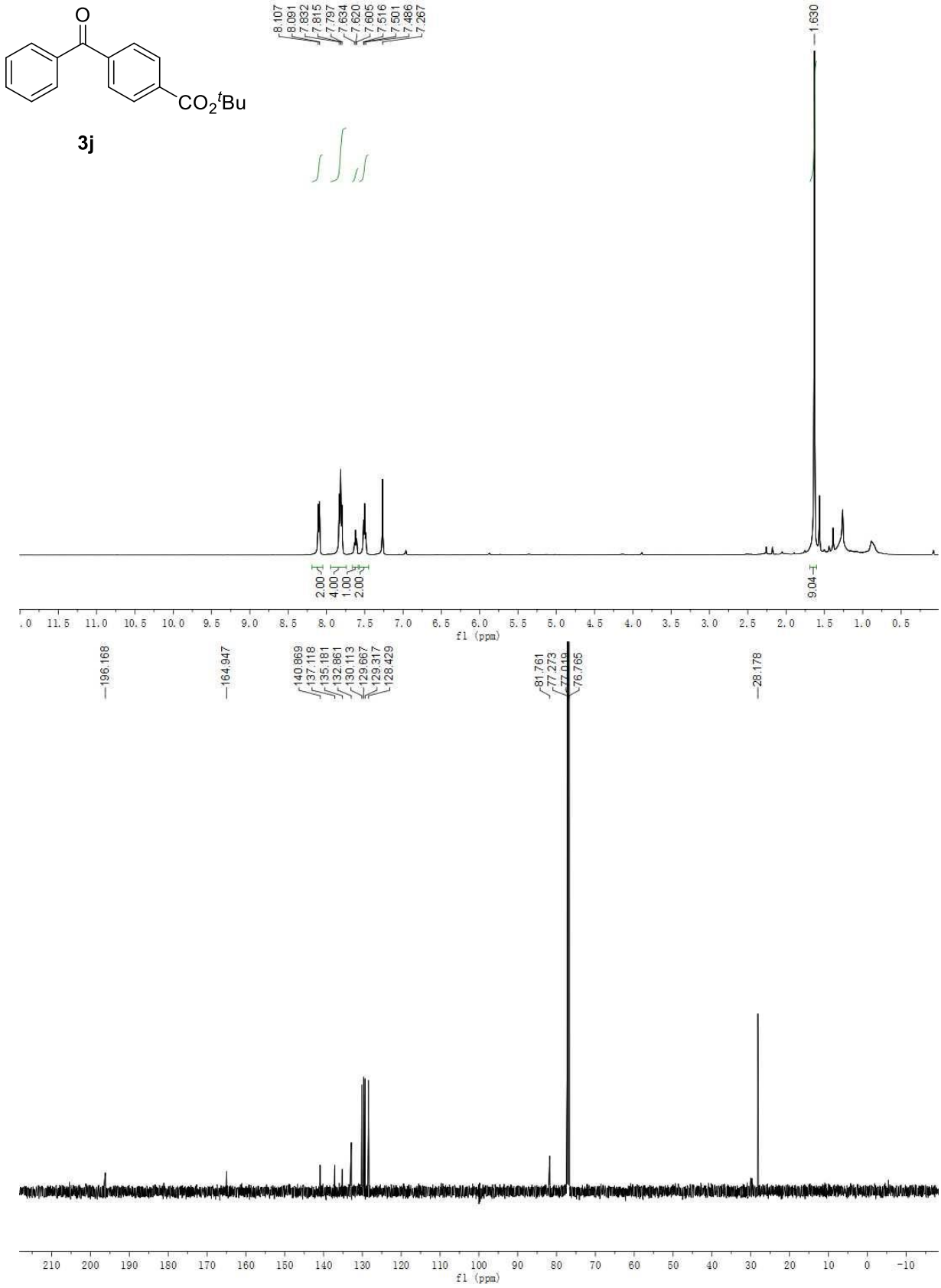

O
CF3

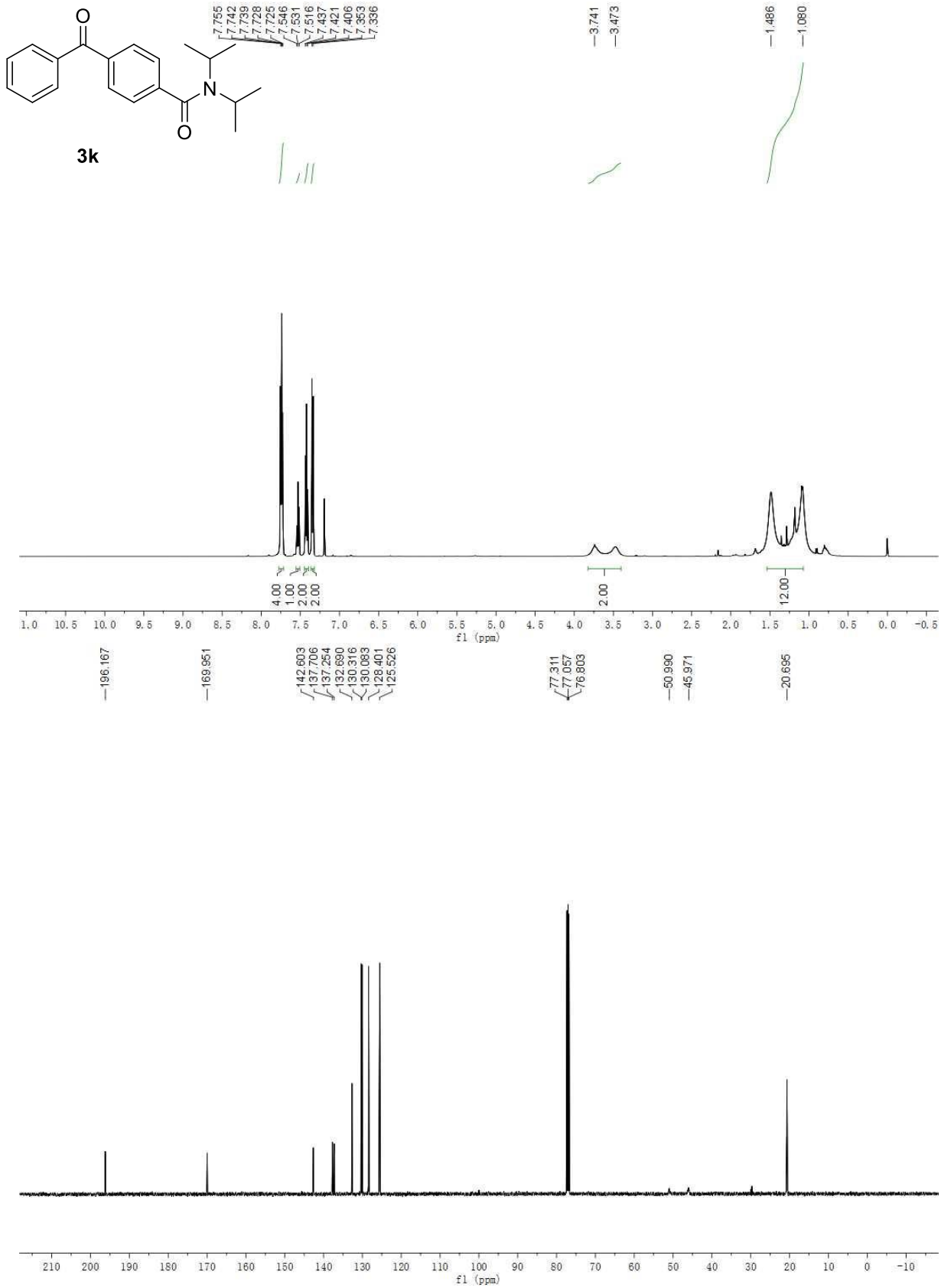
3g

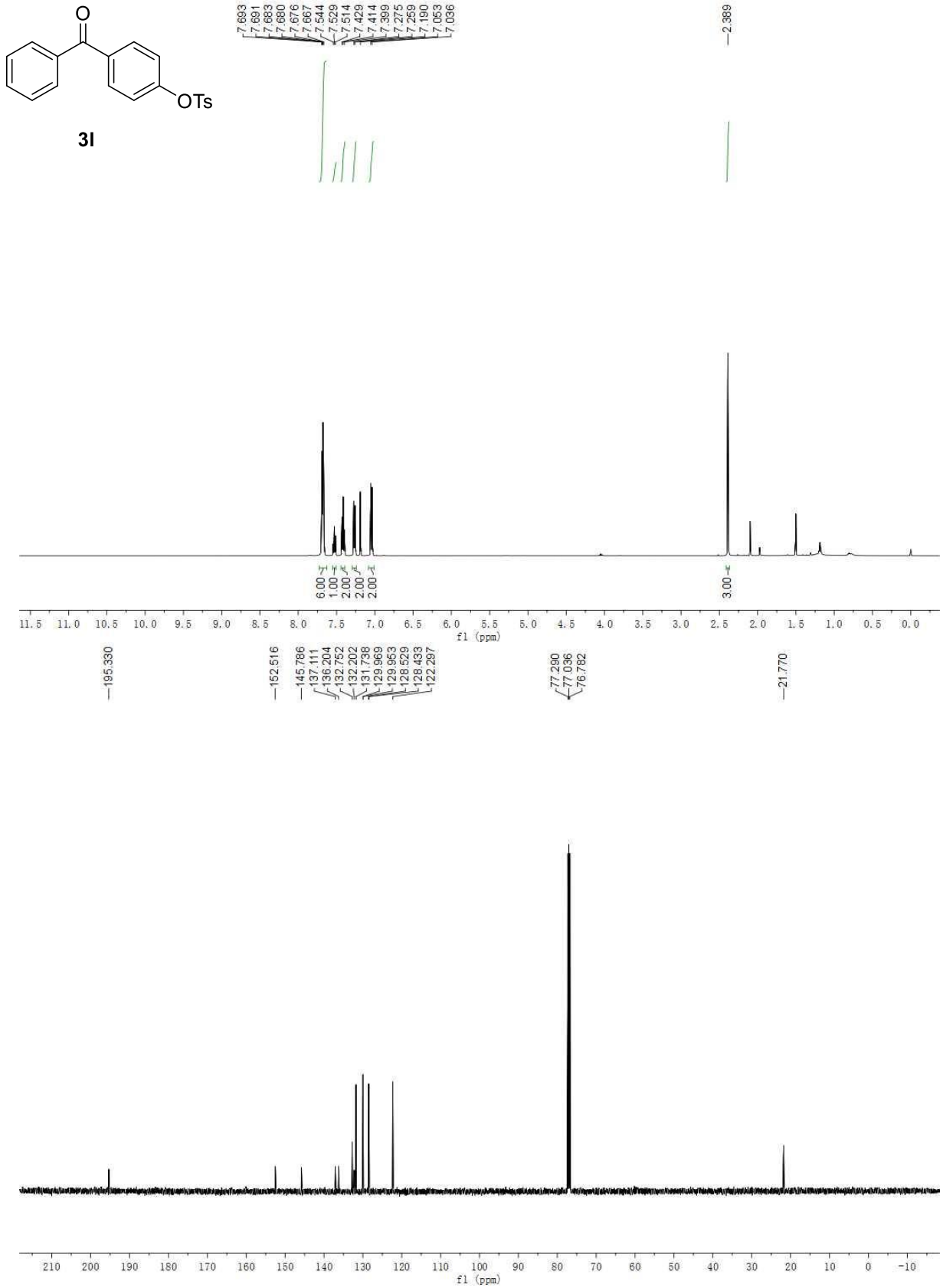
-60.804
20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200 -210
f1 (ppm)

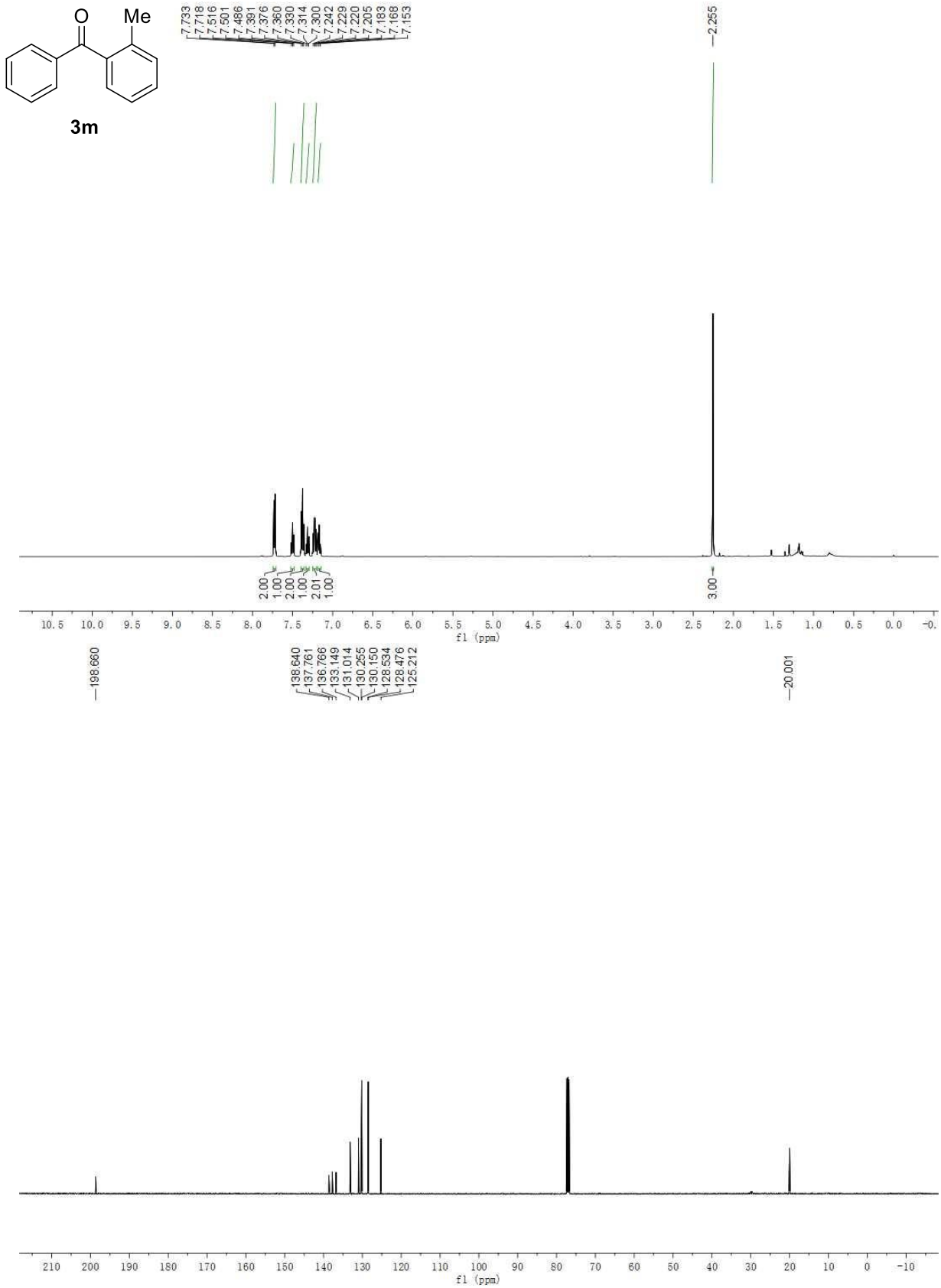

O
CN
3h
7.887
7.871
7.804
7.793
7.788
7.779
7.659
7.644
7.629
7.534
7.518
7.503
7.260
1.557
2.00
4.00
1.00
2.00
f1 (ppm)
195.063
141.259
136.352
133.352
132.192
130.259
130.089
128.659
118.032
115.696
77.286
77.032
76.778
f1 (ppm)

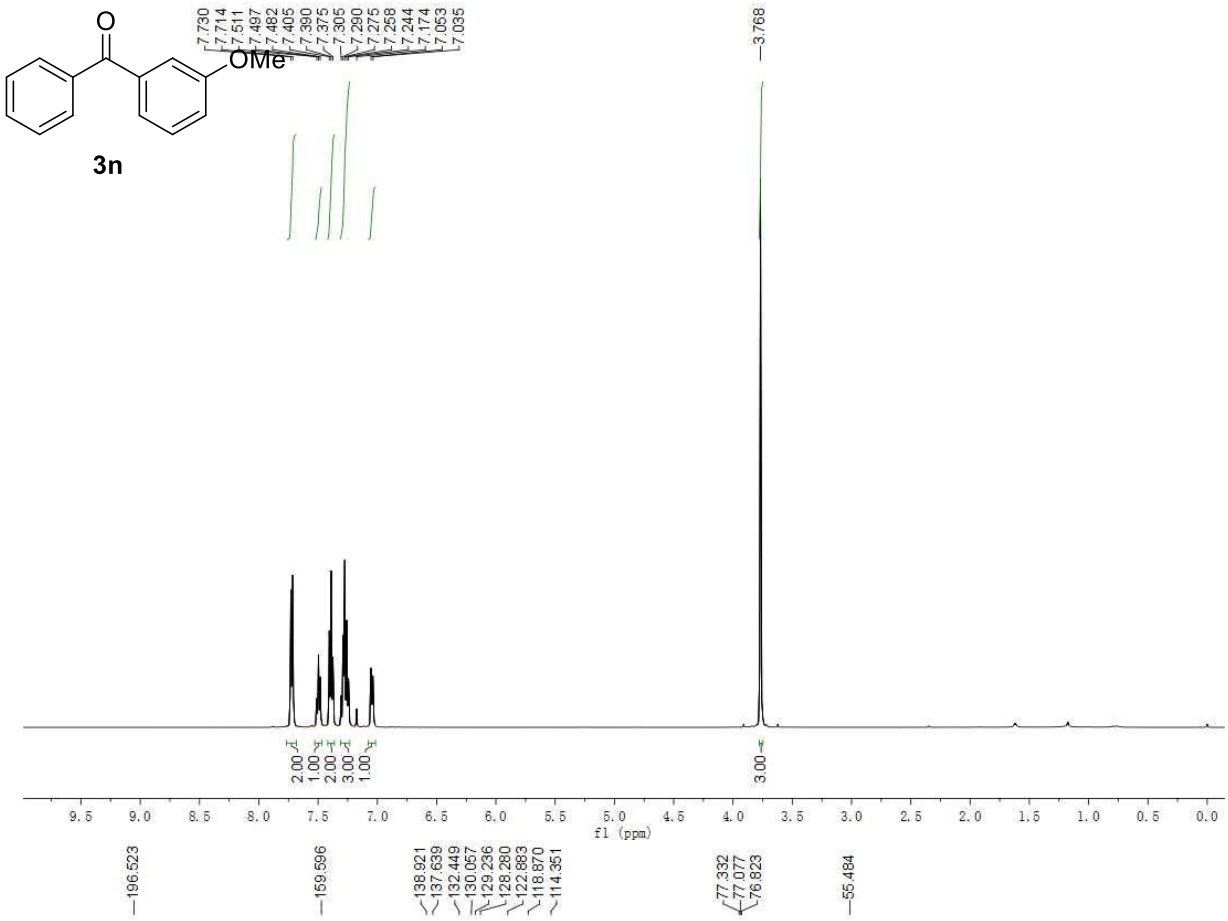

O
CO2Me
3i
8.160
8.144
7.852
7.836
7.814
7.799
7.637
7.623
7.608
7.520
7.504
7.489
3.970
1.548
2.00
2.00
2.00
1.00
2.00
3.00
f1 (ppm)
198.056
168.336
143.339
138.970
135.236
134.963
132.122
131.793
131.518
130.481
79.285
79.031
78.777
54.487
f1 (ppm)

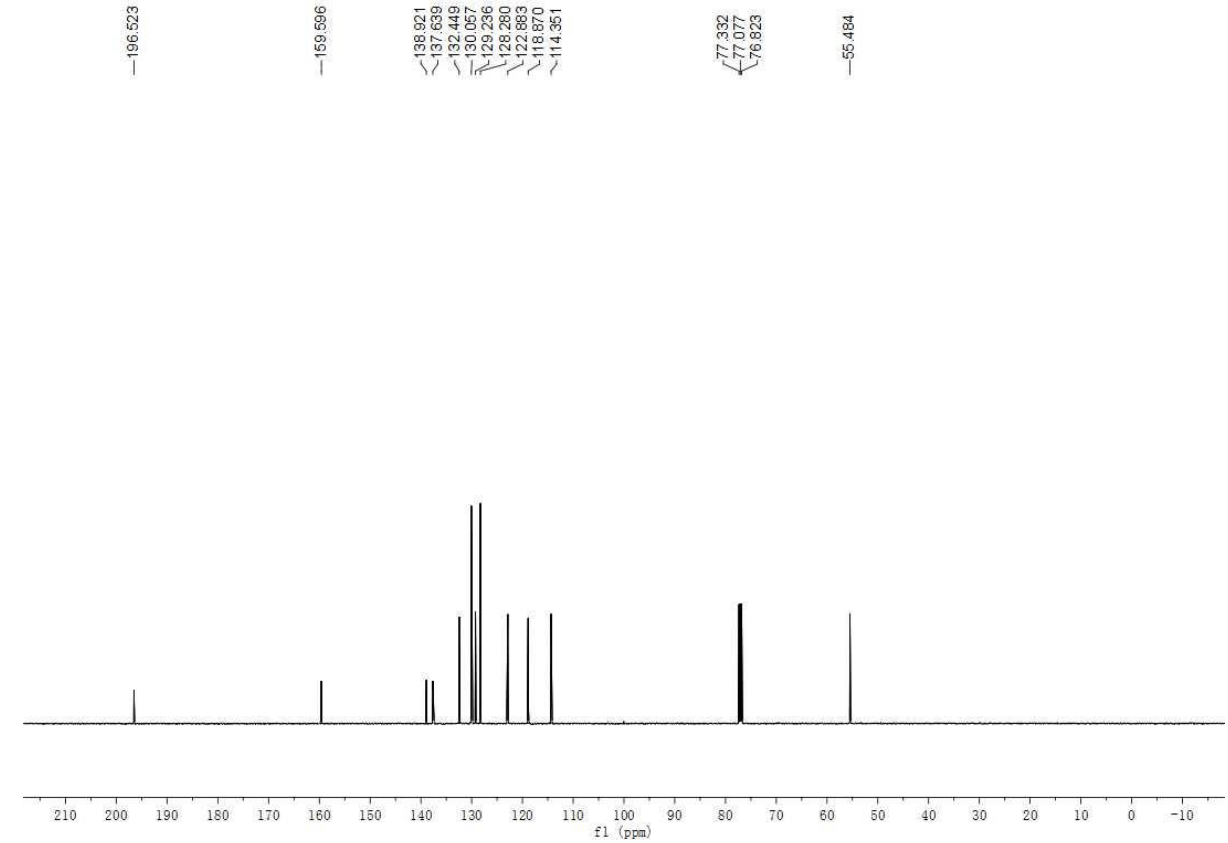

O
CO2tBu
3j
8.107
8.091
7.832
7.815
7.797
7.634
7.620
7.605
7.516
7.501
7.486
7.267
1.630
2.00
4.00
1.00
2.00
9.04
f1 (ppm)
196.168
164.947
140.869
137.118
135.181
132.861
130.113
129.667
129.317
128.429
81.761
77.273
77.019
76.765
28.178
f1 (ppm)

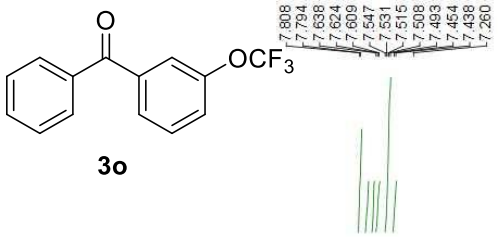

7.755
7.742
7.739
7.728
7.725
7.546
7.531
7.516
7.437
7.421
7.406
7.353
7.336
3.741
3.473
1.486
1.080
3k
4.00
1.00
2.00
2.00
2.00
12.00
f1 (ppm)
196.167
169.951
142.603
137.706
137.254
132.690
130.316
130.083
128.401
125.526
77.311
77.057
76.803
50.990
45.971
20.695
f1 (ppm)


O
OTs
3l
7.693
7.691
7.683
7.680
7.676
7.667
7.544
7.529
7.514
7.429
7.414
7.399
7.275
7.259
7.190
7.053
7.036
2.389
6.00
1.00
2.00
2.00
2.00
3.00
f1 (ppm)
195.330
152.516
145.786
137.111
136.204
132.752
132.202
131.738
129.969
129.953
128.529
128.433
122.297
77.290
77.036
76.782
21.770
f1 (ppm)

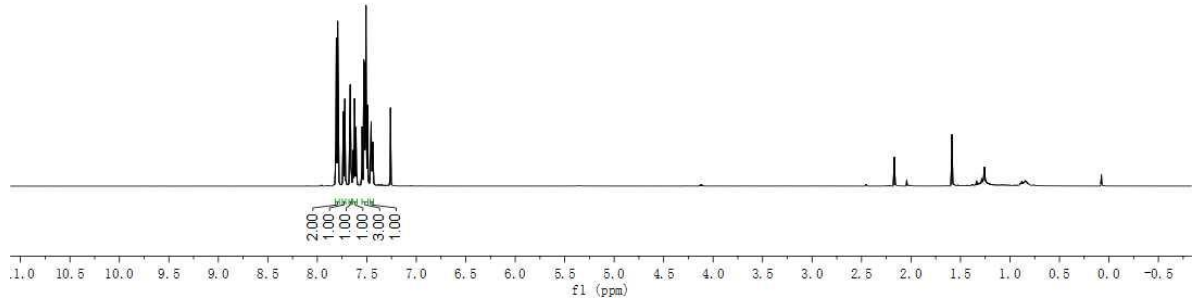

O
Me
3m
7.733
7.718
7.516
7.501
7.486
7.391
7.376
7.360
7.330
7.314
7.300
7.242
7.229
7.220
7.205
7.183
7.168
7.153
2.255
2.00
1.00
2.00
1.00
2.01
1.00
3.00
f1 (ppm)
198.660
138.640
137.761
136.766
133.149
131.014
130.255
130.150
128.534
128.476
125.212
20.001
f1 (ppm)

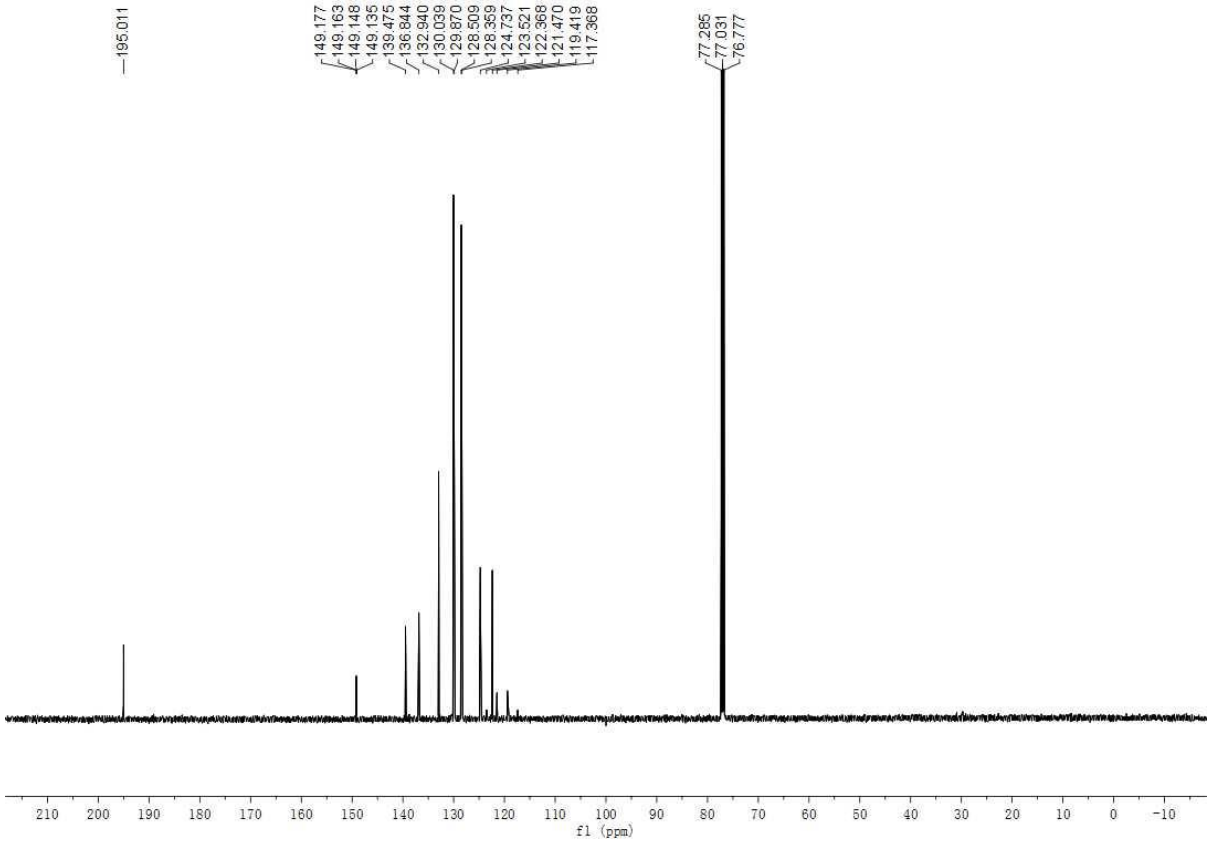

O
OMe
3n
7.730
7.714
7.511
7.497
7.482
7.405
7.390
7.375
7.305
7.290
7.275
7.268
7.244
7.174
7.053
7.035
3.768
2.00
1.00
2.00
3.00
1.00
3.00
f1 (ppm)

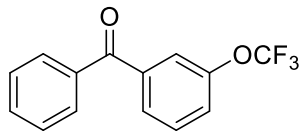

196.523
159.596
138.921
137.639
132.449
130.057
129.236
128.280
122.883
118.870
114.351
77.332
77.077
76.823
55.484
f1 (ppm)


O
OCF3
7.808
7.794
7.638
7.624
7.609
7.547
7.531
7.515
7.508
7.493
7.454
7.438
7.260
1.586

3o

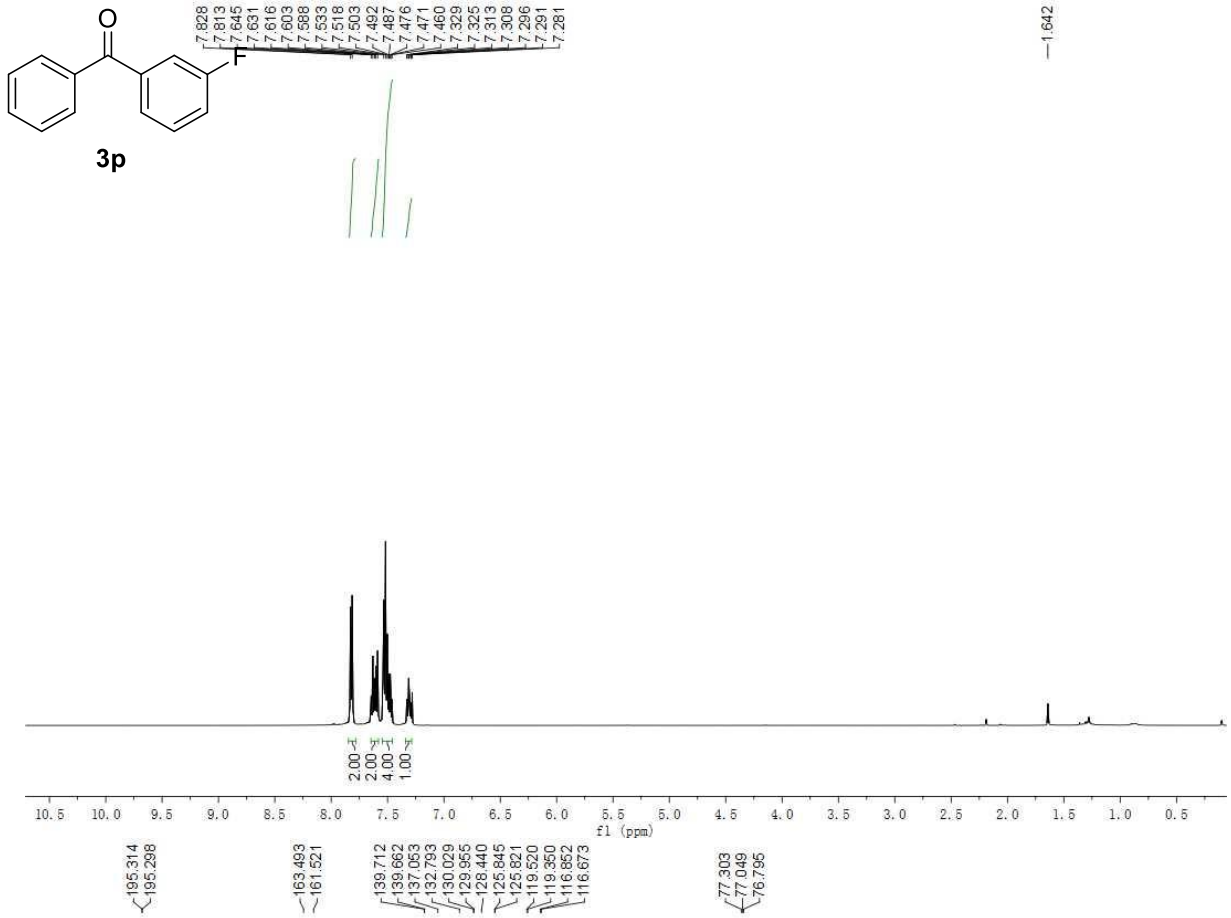

2.00
1.00
1.00
1.00
3.00
1.00
f1 (ppm)

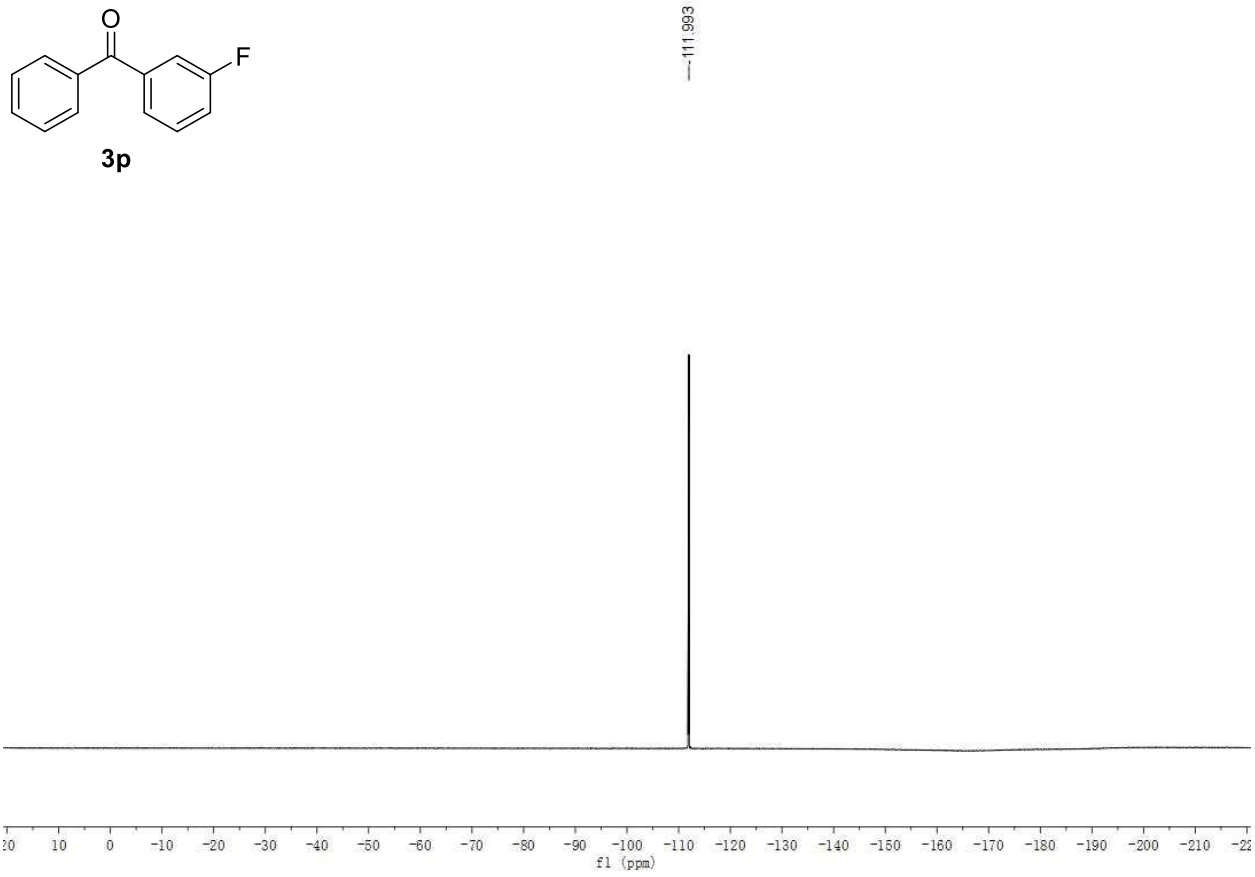

195.011
149.177
149.163
149.148
149.135
139.475
136.844
132.940
130.039
129.870
128.509
128.359
124.737
123.521
122.368
121.470
119.419
117.368
77.285
77.031
76.777
f1 (ppm)

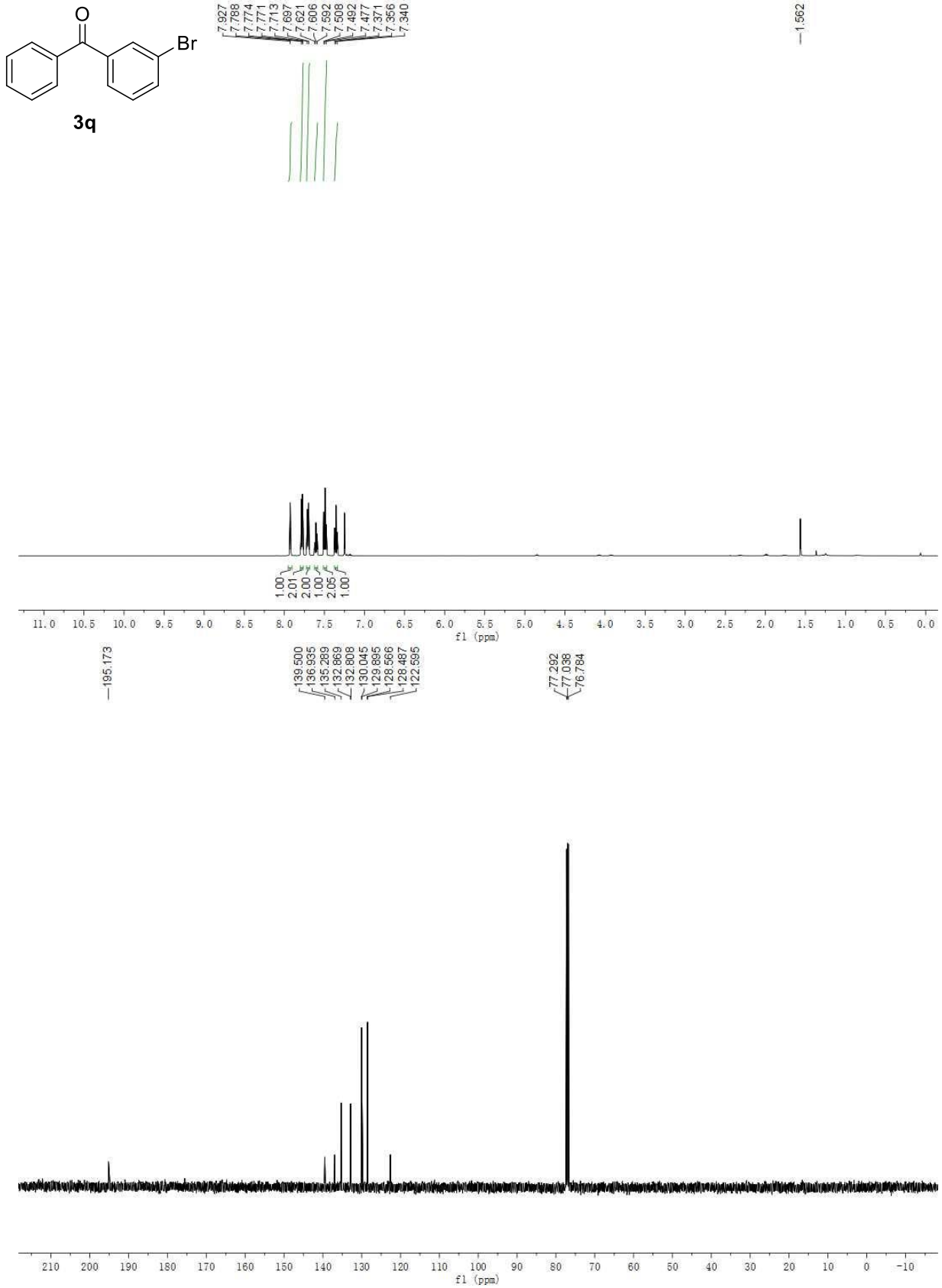

O
OCF3

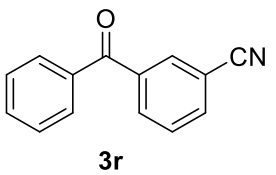
3o

-57.877
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)


O
F
3p
7.828
7.813
7.645
7.631
7.616
7.603
7.588
7.533
7.518
7.503
7.492
7.487
7.476
7.471
7.460
7.329
7.325
7.313
7.308
7.296
7.291
7.281
1.642
2.00
2.00
4.00
1.00
f1 (ppm)
195.314
195.298
163.493
161.521
139.712
139.662
137.053
132.793
130.029
129.955
128.440
125.845
125.821
119.520
119.350
116.852
116.673
77.303
77.049
76.795
f1 (ppm)

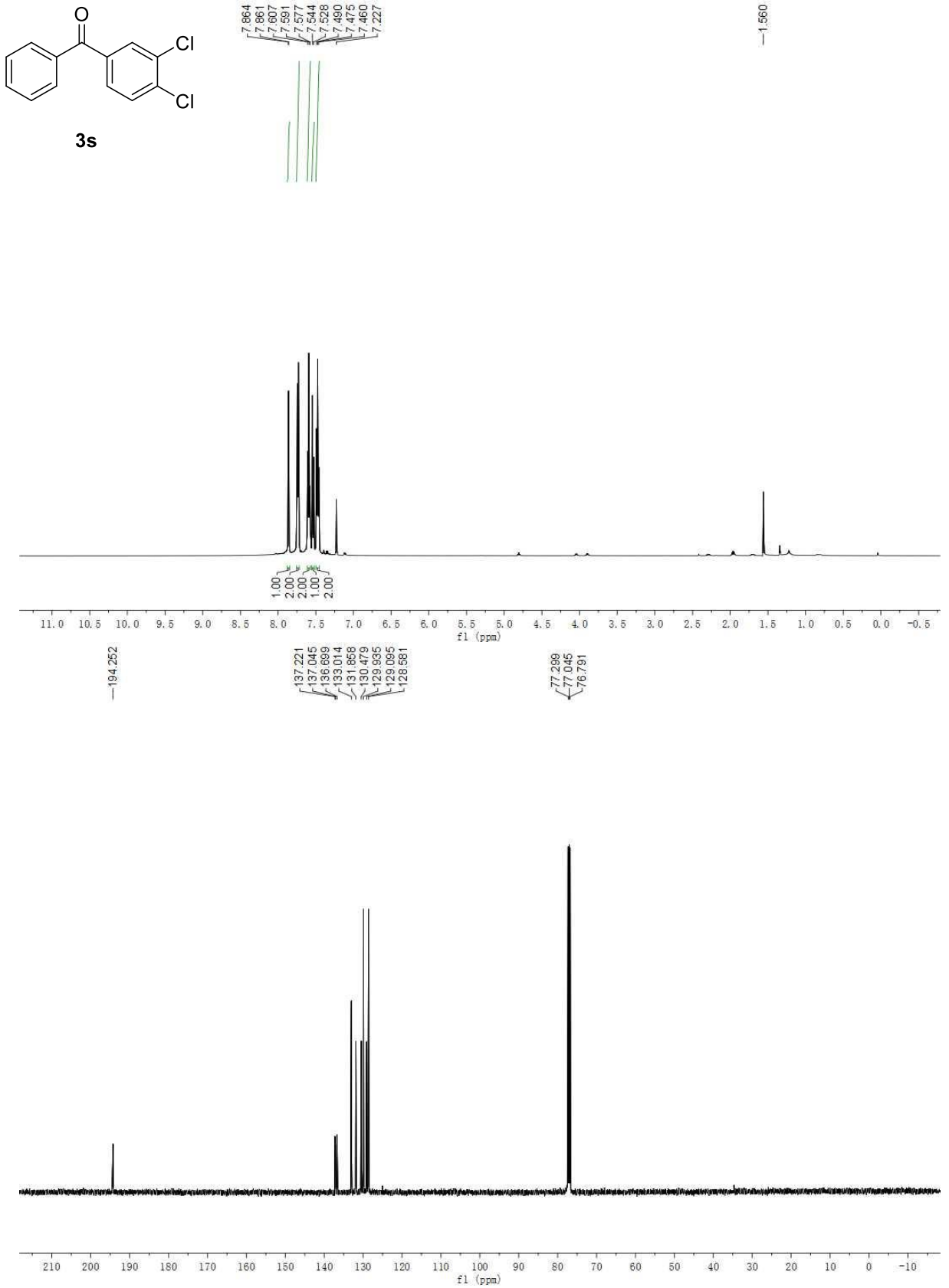

O
F
3p
-111.993
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

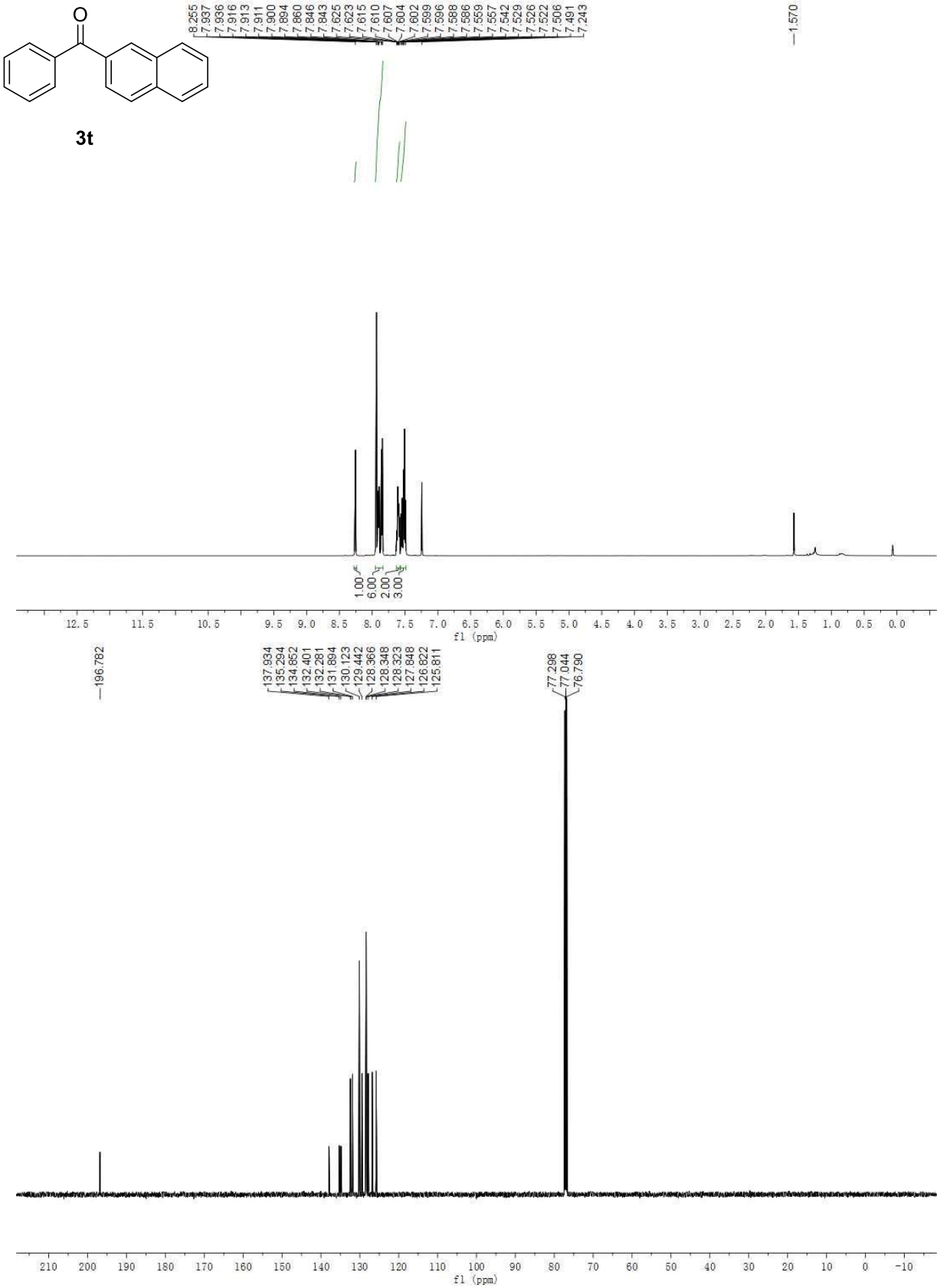

O
Br
3q
7.927
7.788
7.774
7.771
7.713
7.697
7.621
7.606
7.592
7.508
7.492
7.477
7.371
7.356
7.340
1.562
1.00
2.01
2.00
1.00
2.05
1.00
f1 (ppm)
195.173
139.500
136.935
135.289
132.869
132.808
130.045
129.895
128.566
128.487
122.595
77.292
77.038
76.784
f1 (ppm)

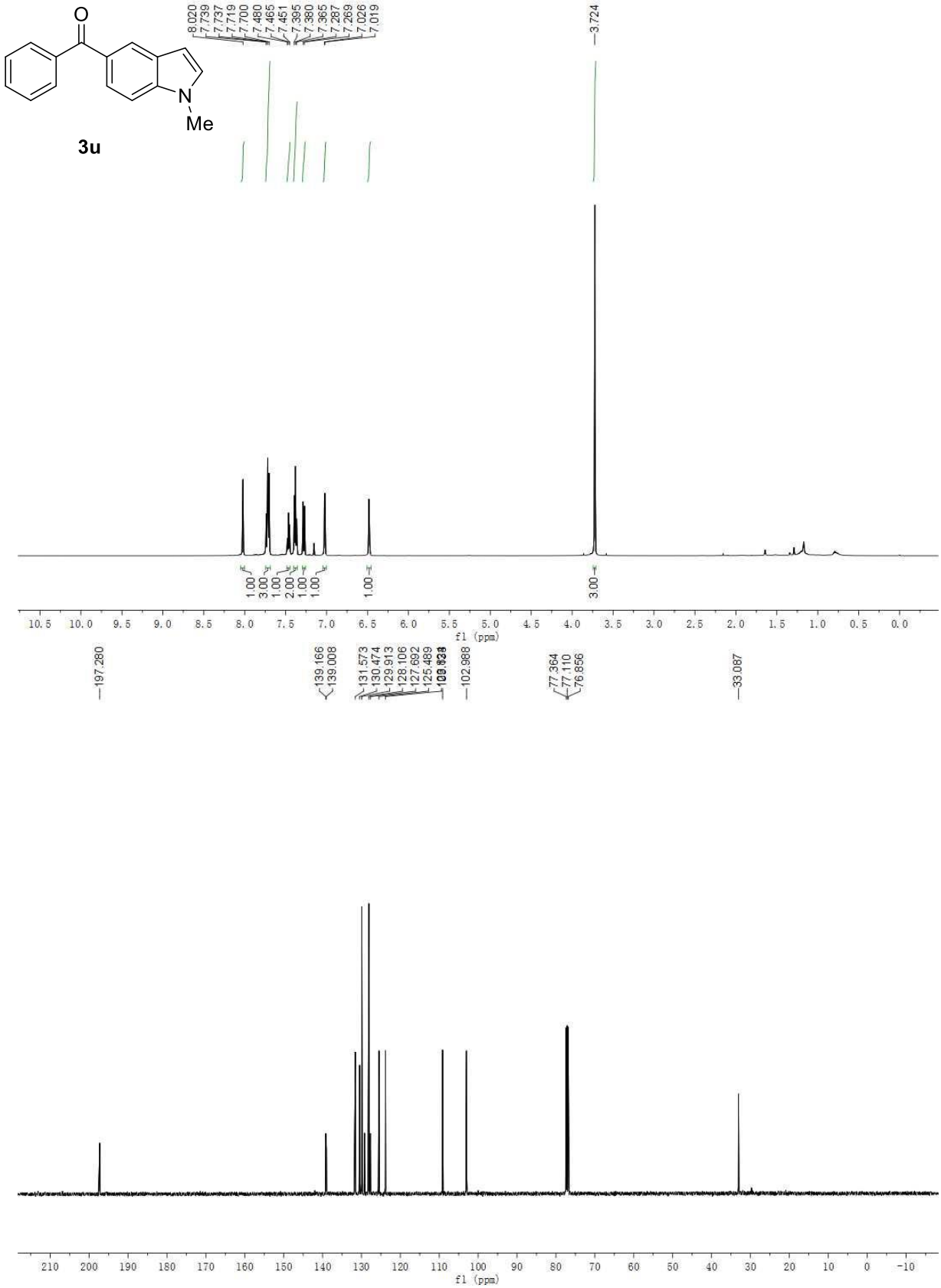

O
CN

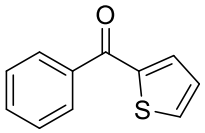
3r

8.070
8.051
8.035
7.880
7.865
7.787
7.771
7.665
7.651
7.637
7.621
7.543
7.528
7.512
1.569
1.00
1.00
1.00
2.00
2.00
2.00
f1 (ppm)
194.424
138.638
136.334
135.368
133.858
133.488
133.303
130.019
129.419
128.699
117.961
112.869
77.289
77.036
76.781
f1 (ppm)

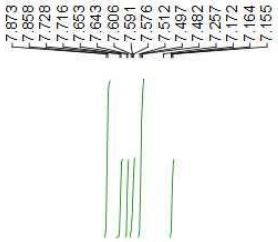

O
Cl
Cl
3s
7.864
7.861
7.607
7.591
7.577
7.544
7.528
7.490
7.475
7.460
7.227
1.560
1.00
2.00
2.00
1.00
2.00
f1 (ppm)
194.252
137.221
137.045
136.699
133.014
131.858
130.479
129.935
129.095
128.581
77.299
77.045
76.791
f1 (ppm)

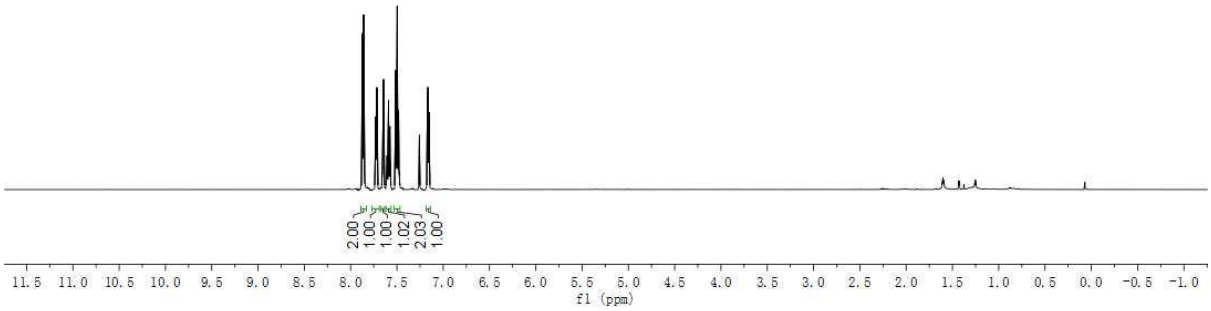

3t
8.255
7.937
7.936
7.916
7.913
7.911
7.900
7.894
7.860
7.846
7.843
7.625
7.623
7.615
7.610
7.607
7.604
7.602
7.599
7.596
7.588
7.586
7.559
7.557
7.542
7.529
7.526
7.522
7.506
7.491
7.243
1.570
1.00
6.00
2.00
3.00
f1 (ppm)
196.782
137.934
135.294
134.852
132.401
132.281
131.894
130.123
129.442
128.366
128.348
128.323
127.848
126.822
125.811
77.298
77.044
76.790
f1 (ppm)

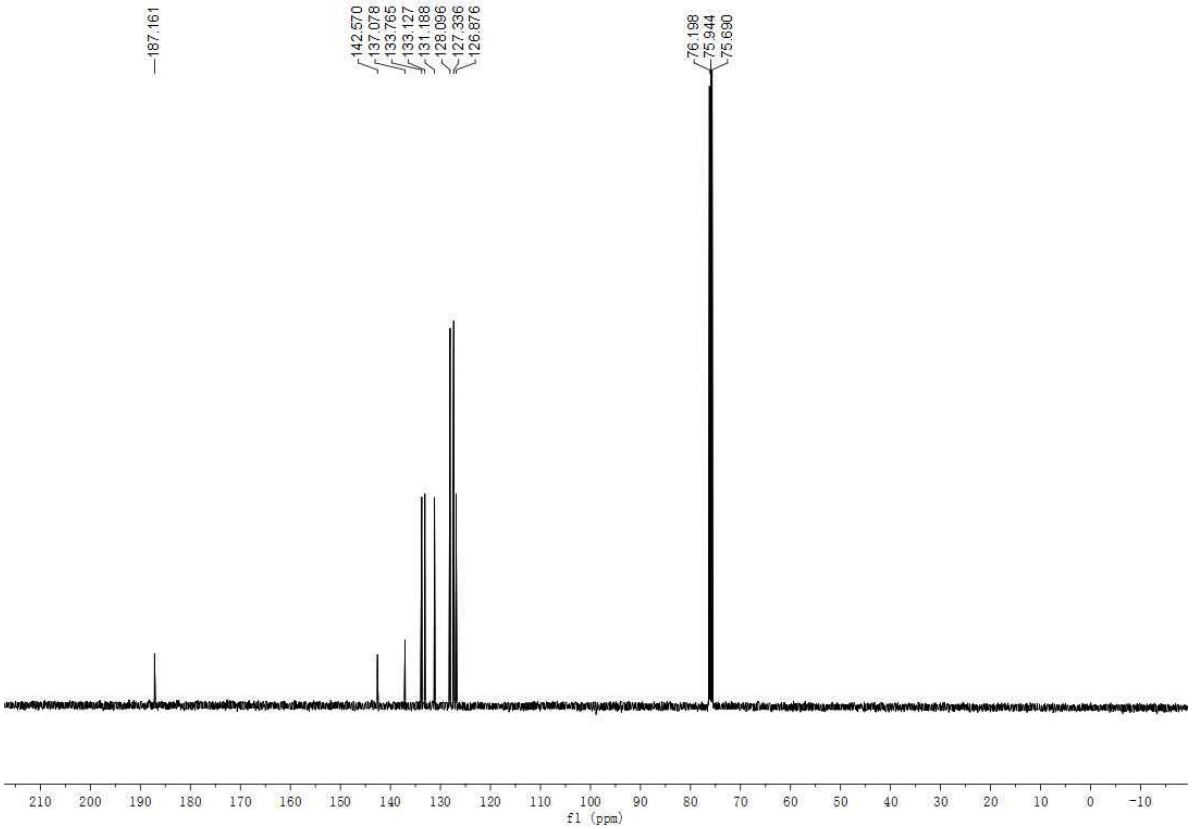

O
N
Me
3u
8.020
7.739
7.737
7.719
7.700
7.480
7.465
7.451
7.395
7.380
7.365
7.287
7.269
7.026
7.019
3.724
1.00
3.00
1.00
2.00
1.00
1.00
1.00
3.00
f1 (ppm)
197.280
139.166
139.008
131.573
130.474
129.913
128.106
127.692
125.489
102.988
77.364
77.110
76.856
33.087
f1 (ppm)

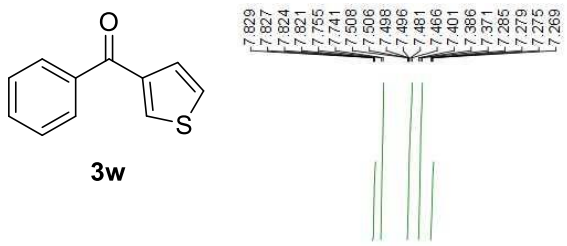


3v

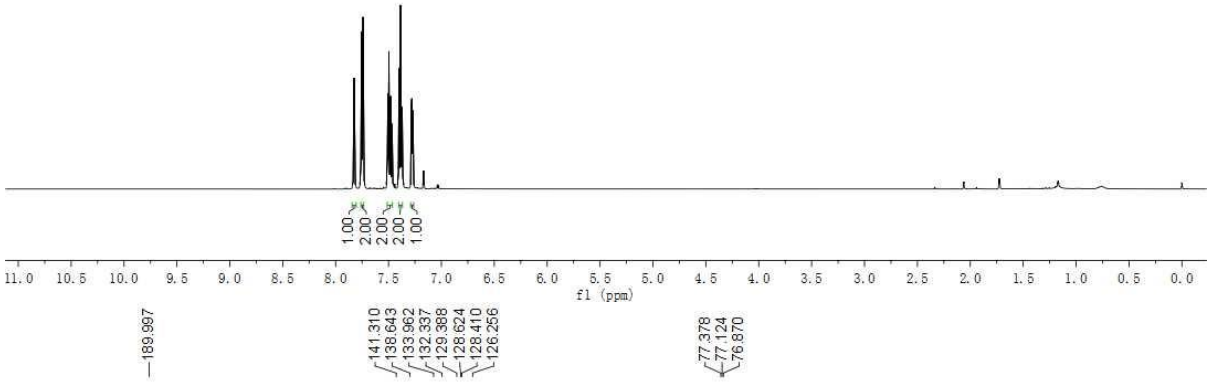

7.873
7.858
7.728
7.716
7.653
7.643
7.606
7.591
7.576
7.512
7.497
7.482
7.257
7.172
7.164
7.155


2.00
1.00
1.00
1.02
2.03
1.00
f1 (ppm)

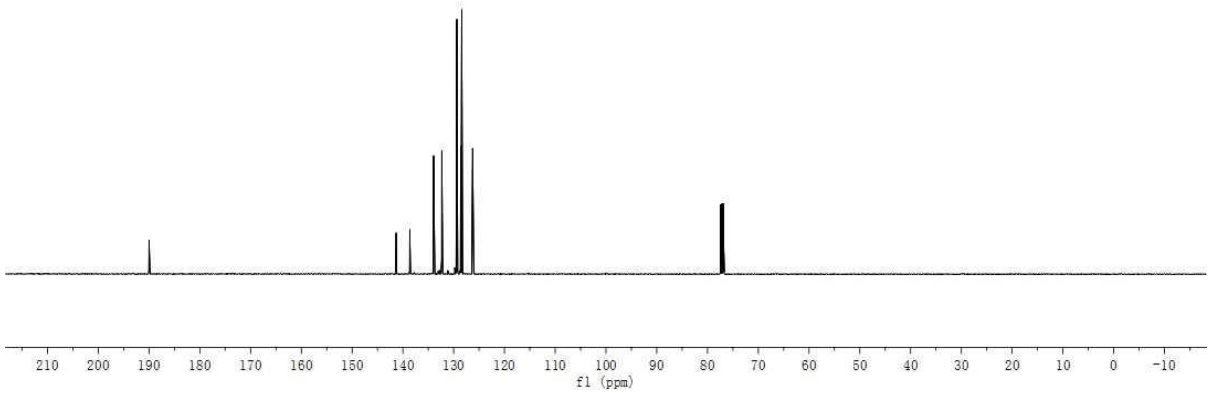

187.161
142.570
137.078
133.765
133.127
131.188
128.096
127.336
126.876
76.198
75.944
75.690
f1 (ppm)

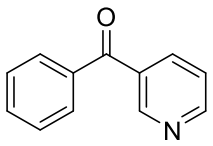

O
S
7.829
7.827
7.824
7.821
7.755
7.741
7.508
7.506
7.498
7.496
7.481
7.466
7.401
7.386
7.371
7.285
7.279
7.275
7.269

3w

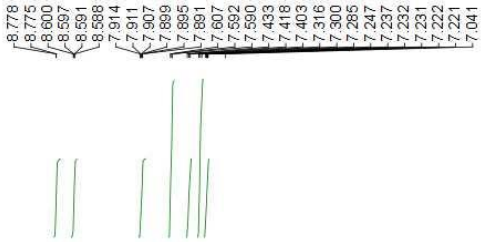

1.00
2.00
2.00
2.00
1.00
11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

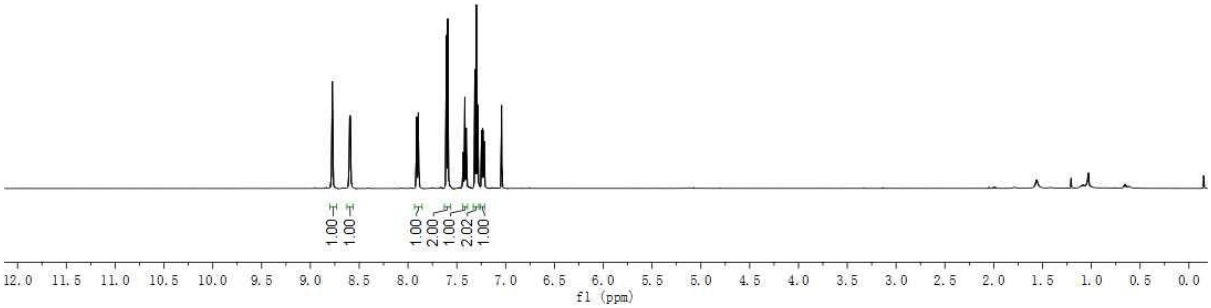
189.997
141.310
138.643
133.962
132.337
129.388
128.624
128.410
126.256
77.378
77.124
76.870


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

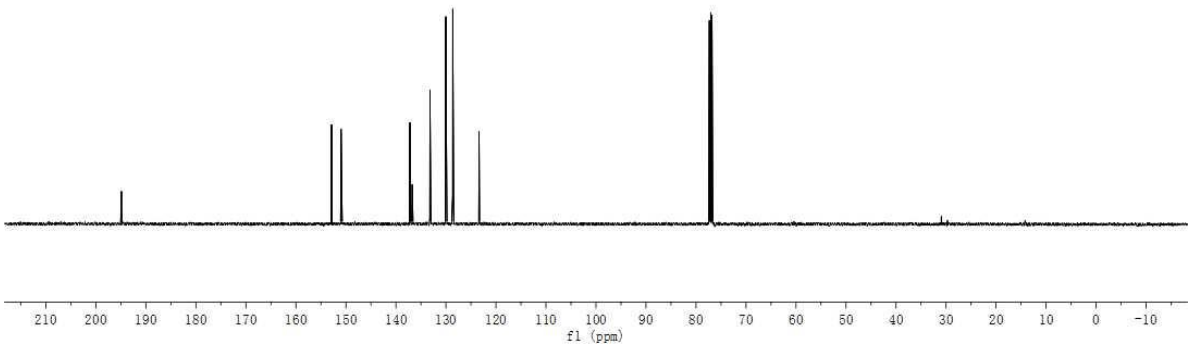


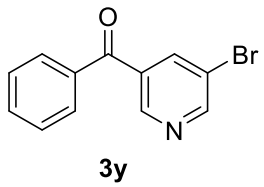
3x


8.778
8.775
8.600
8.597
8.591
8.588
7.914
7.911
7.907
7.899
7.895
7.881
7.607
7.592
7.590
7.433
7.418
7.403
7.316
7.300
7.285
7.247
7.237
7.232
7.231
7.222
7.221
7.041

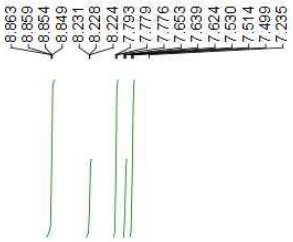

1.00
1.00
1.00
2.00
1.00
2.02
1.00
f1 (ppm)

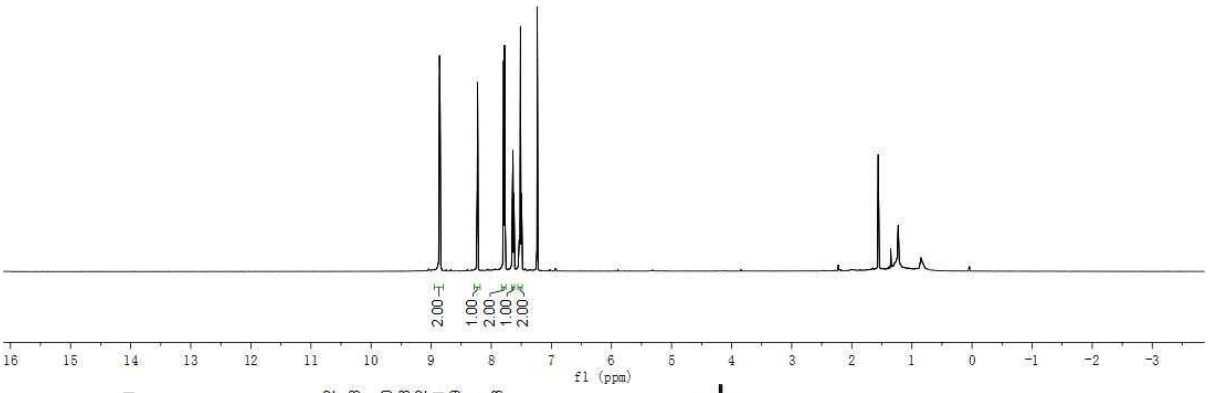

194.901
152.867
150.974
137.193
136.729
133.192
130.041
128.637
123.377
77.309
77.055
76.801

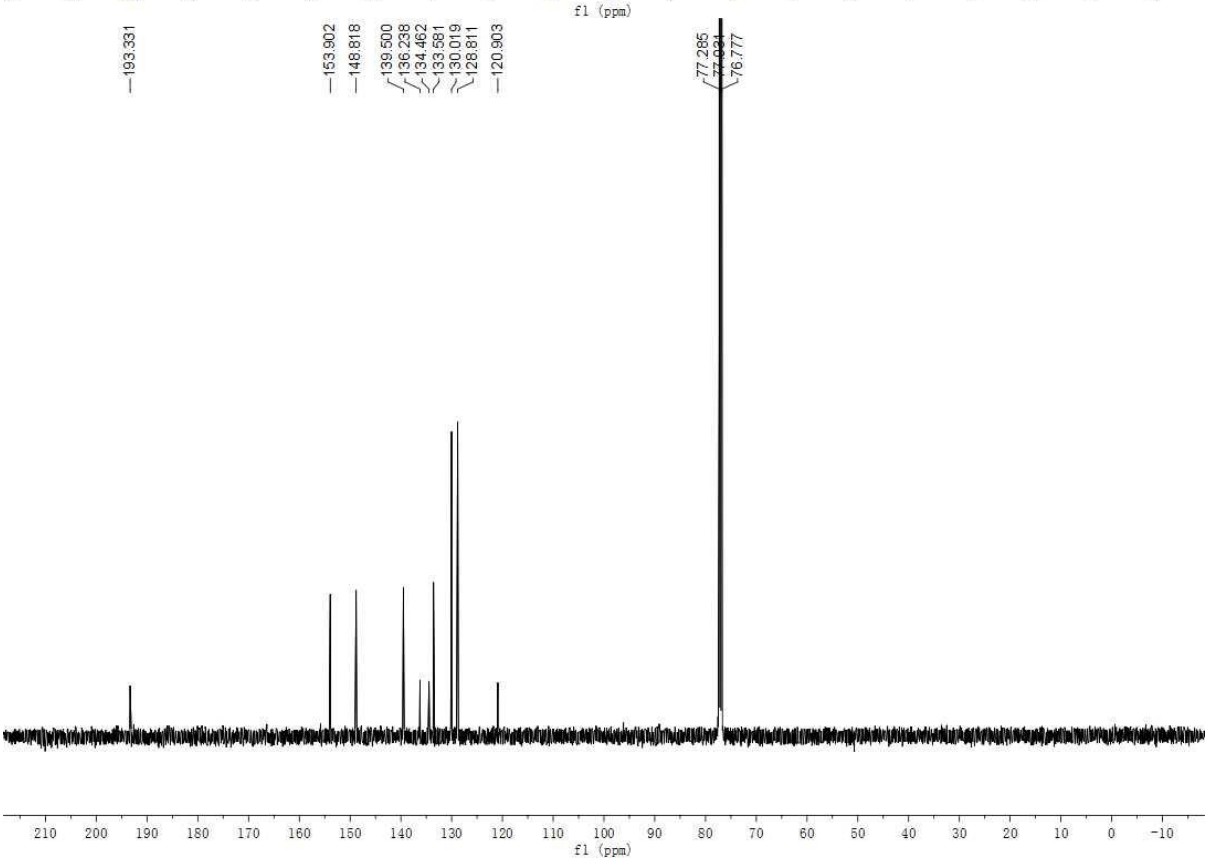

f1 (ppm)

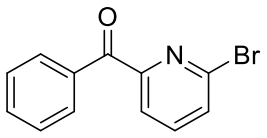

O
Br
N

3y

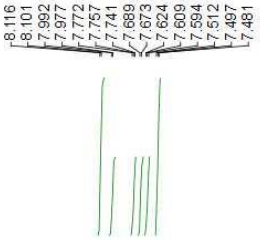

8.863
8.859
8.854
8.849
8.231
8.228
8.224
7.793
7.779
7.776
7.653
7.639
7.624
7.530
7.514
7.499
7.235
1.560

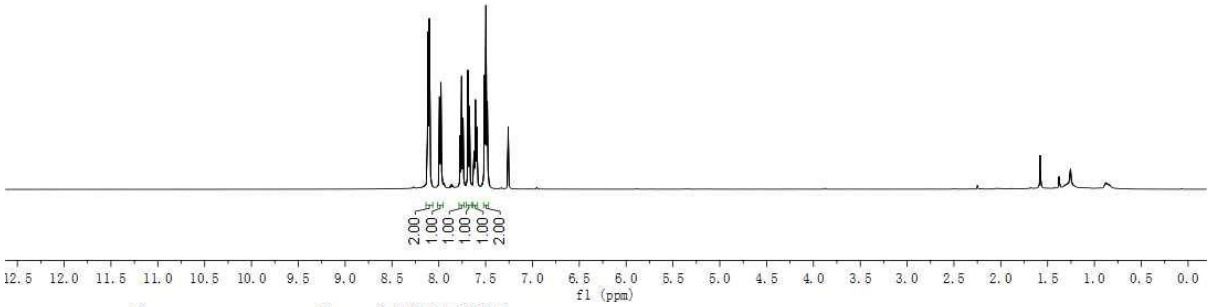

2.00
1.00
2.00
1.00
2.00
f1 (ppm)

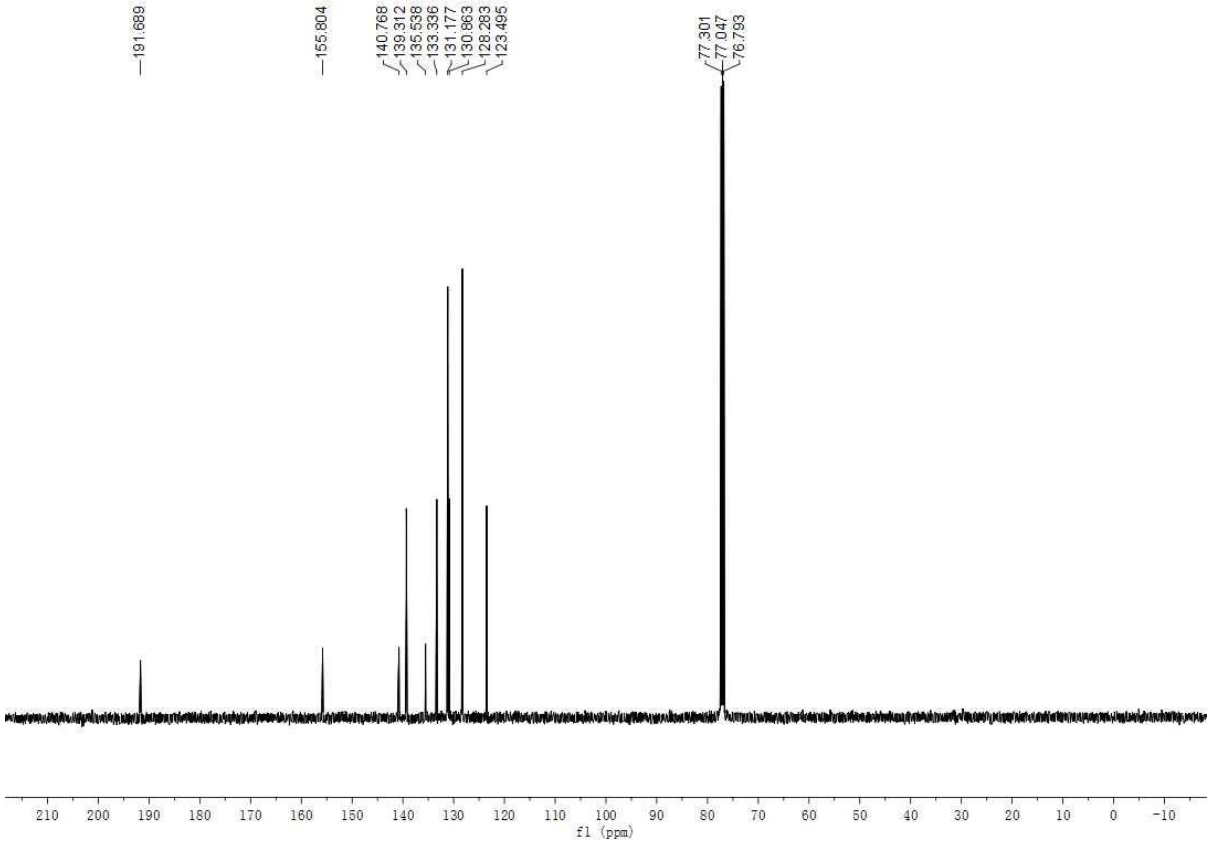

193.331
153.902
148.818
139.500
136.238
134.462
133.581
130.019
128.811
120.903
77.285
77.031
76.777
f1 (ppm)

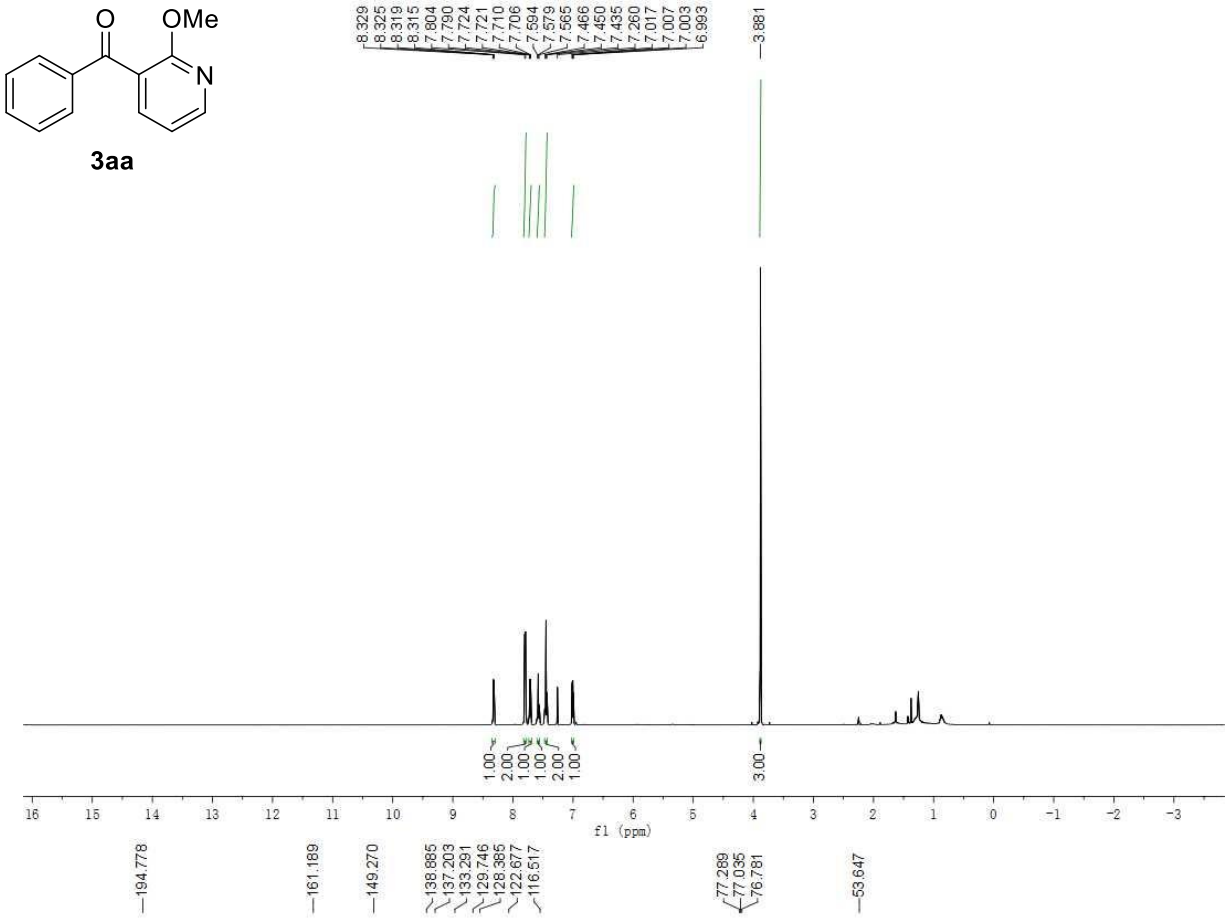

O
N
Br

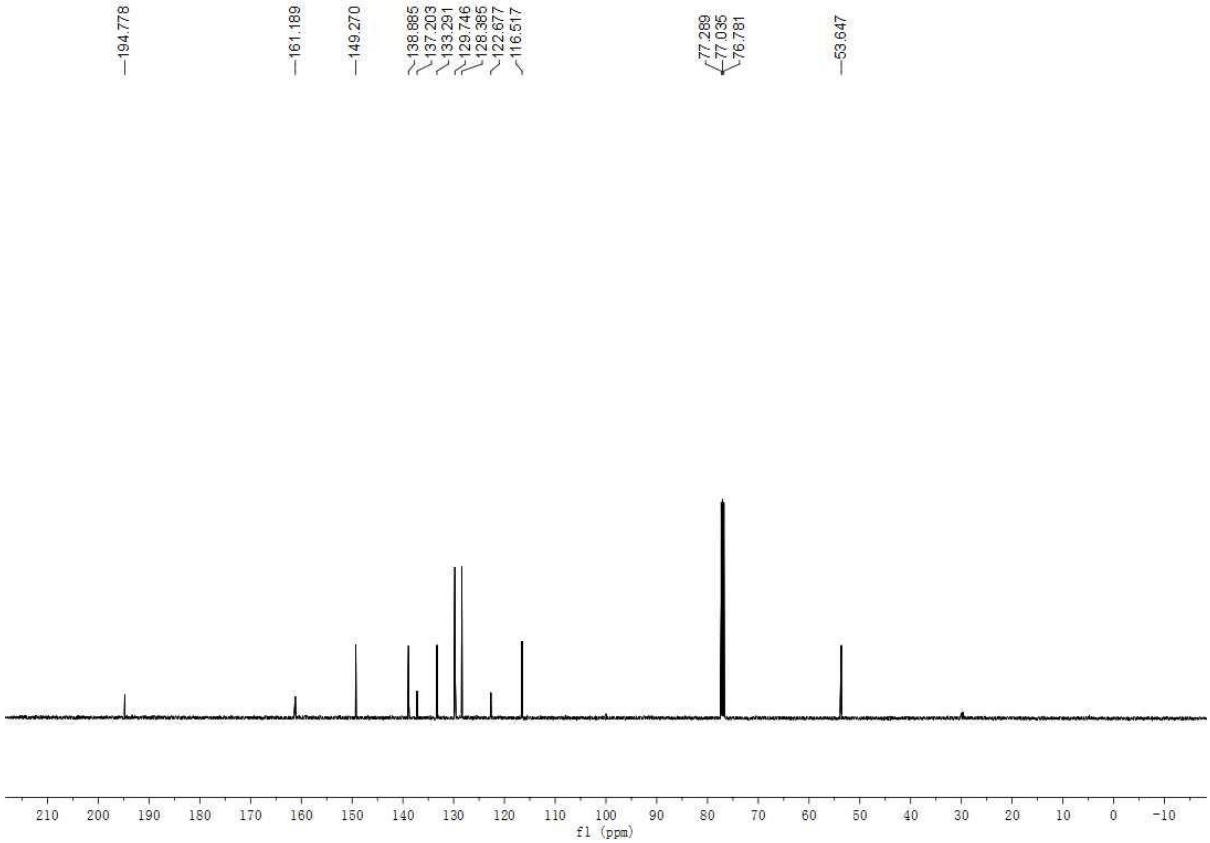
3z

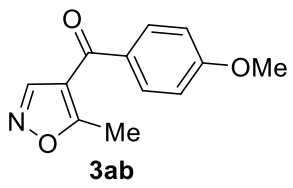

8.116
8.101
7.992
7.977
7.772
7.757
7.741
7.689
7.673
7.624
7.609
7.594
7.512
7.497
7.481


2.00
1.00
1.00
1.00
1.00
2.00
f1 (ppm)


191.689
155.804
140.768
139.312
135.538
133.336
131.177
130.863
128.283
123.495
77.301
77.047
76.793
f1 (ppm)

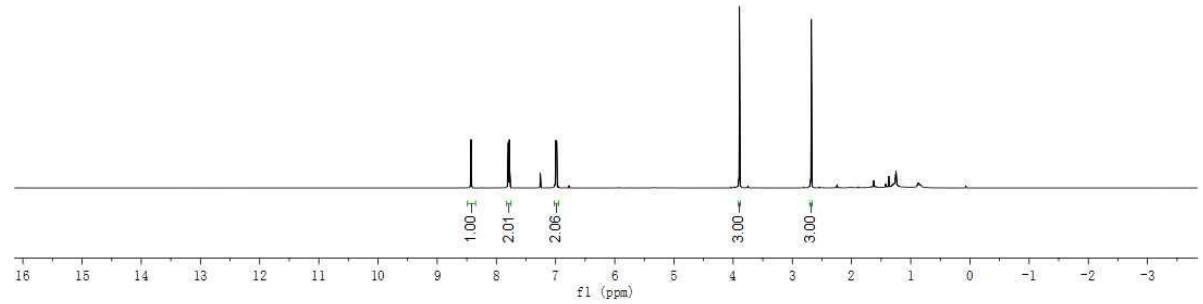

O
OMe
N
3aa
8.329
8.325
8.319
8.315
7.804
7.790
7.724
7.721
7.710
7.706
7.594
7.579
7.565
7.466
7.450
7.435
7.260
7.017
7.007
7.003
6.993
3.881
1.00
2.00
1.00
1.00
2.00
1.00
3.00
f1 (ppm)


194.778
161.189
149.270
138.885
137.203
133.291
129.746
128.385
122.677
116.517
77.289
77.035
76.781
53.647
f1 (ppm)

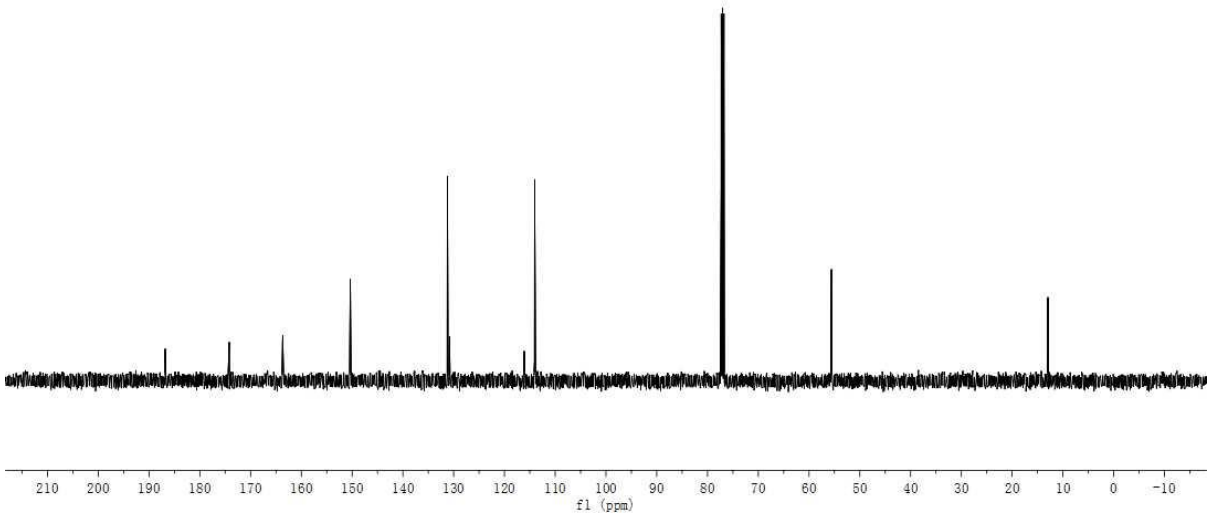

O
OMe
N
O
Me

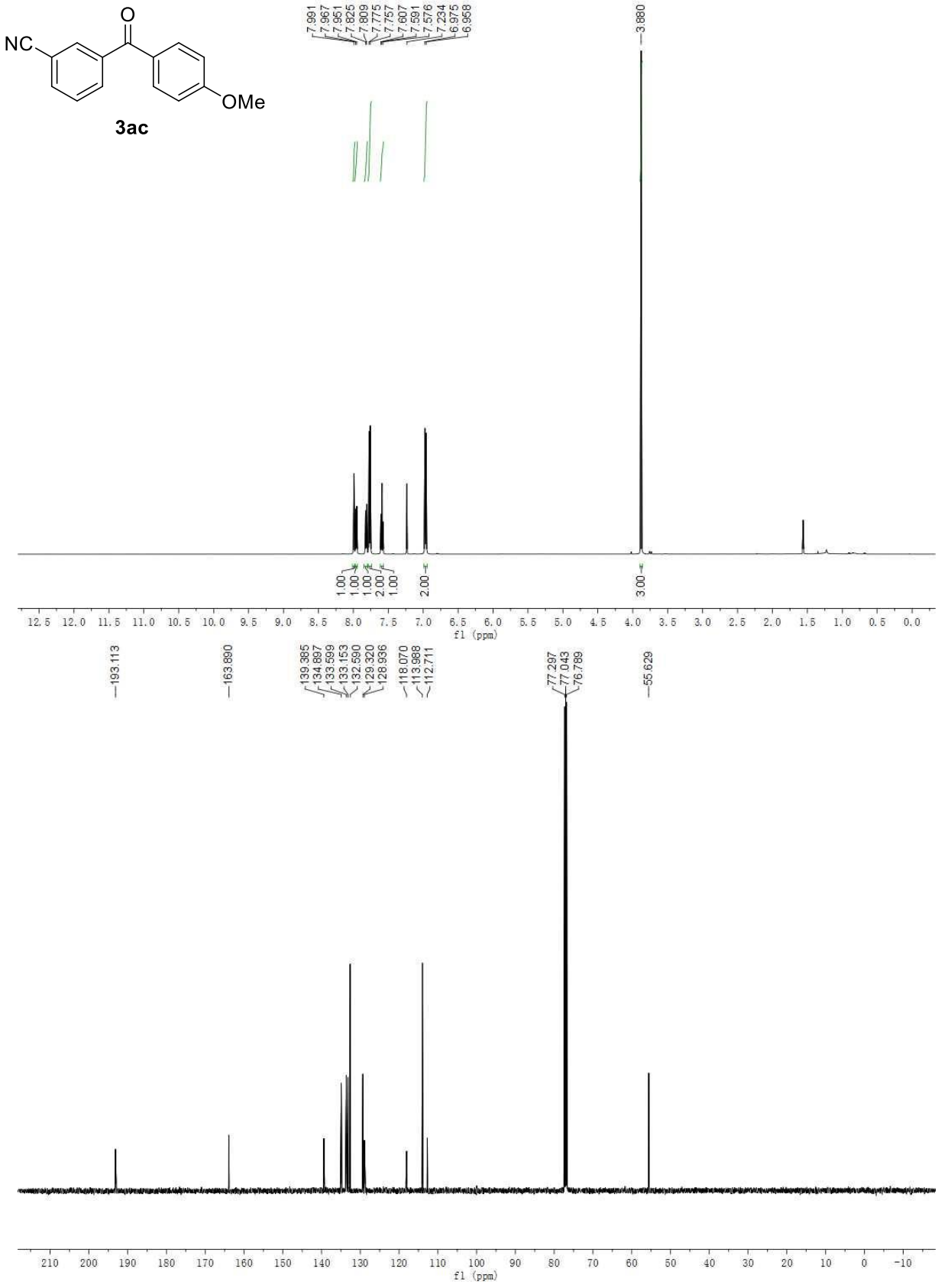
3ab

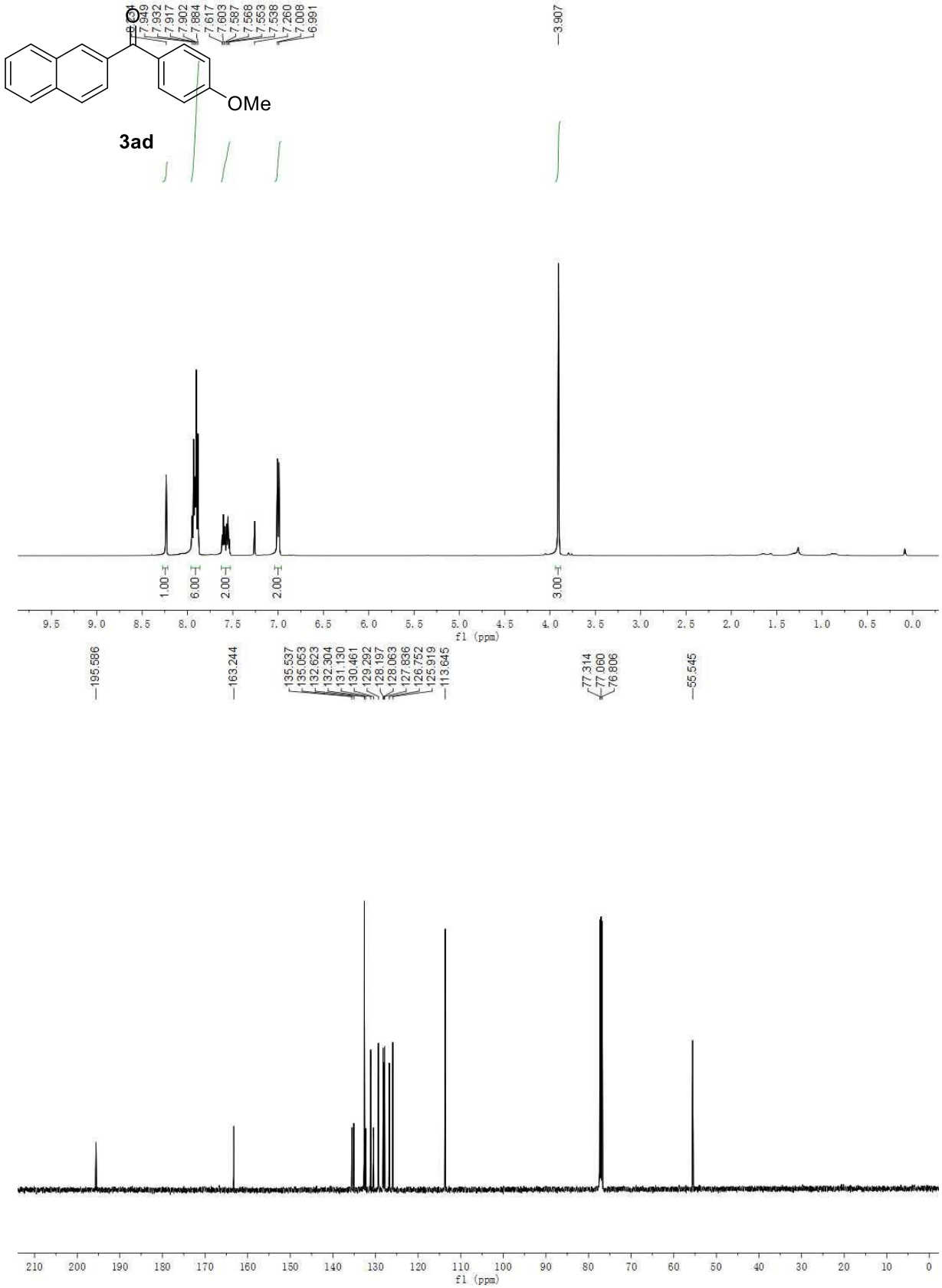
8.429
7.799
7.782
6.999
6.981
3.894
2.680

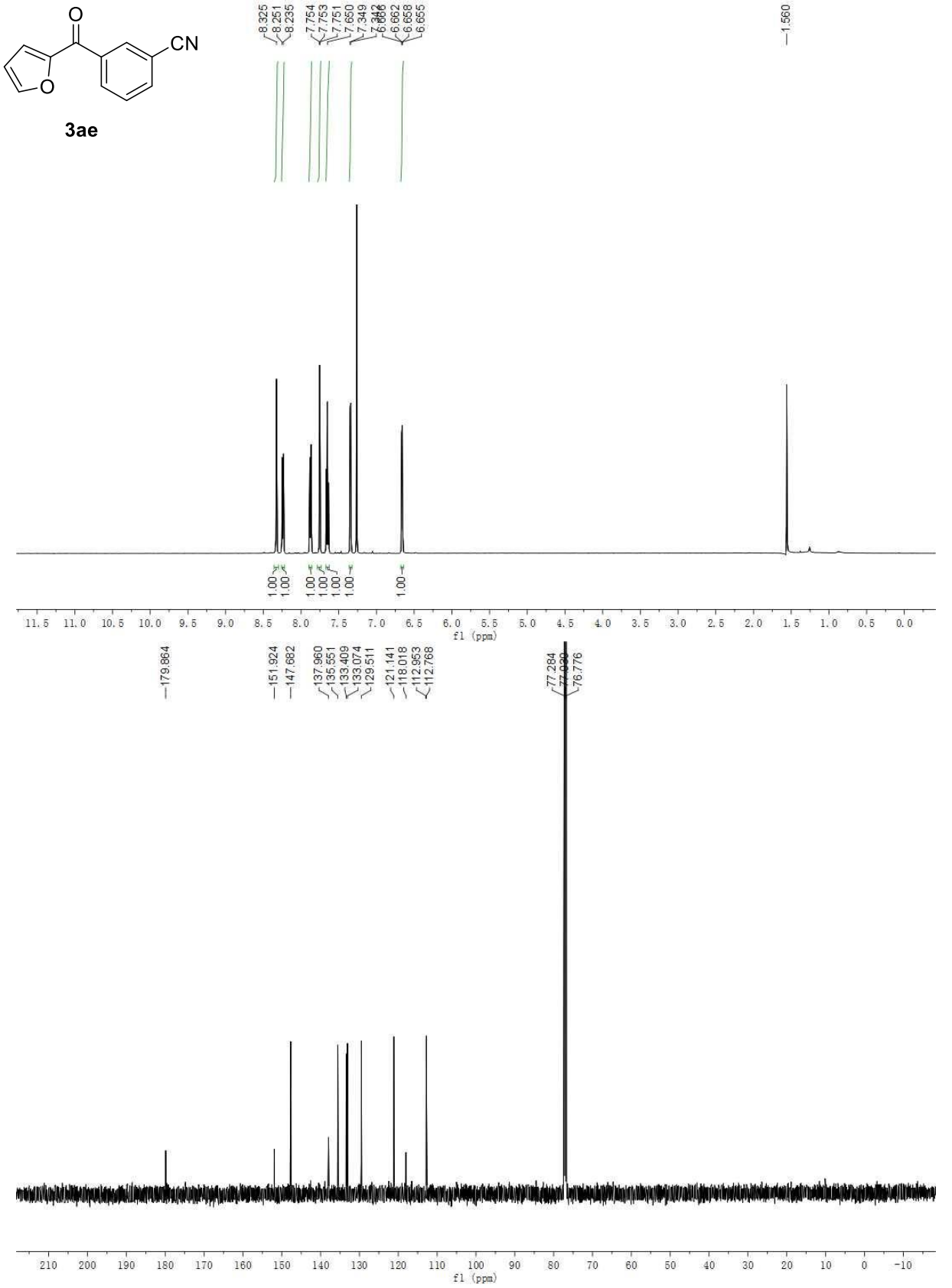

1.00
2.01
2.06
3.00
3.00
f1 (ppm)

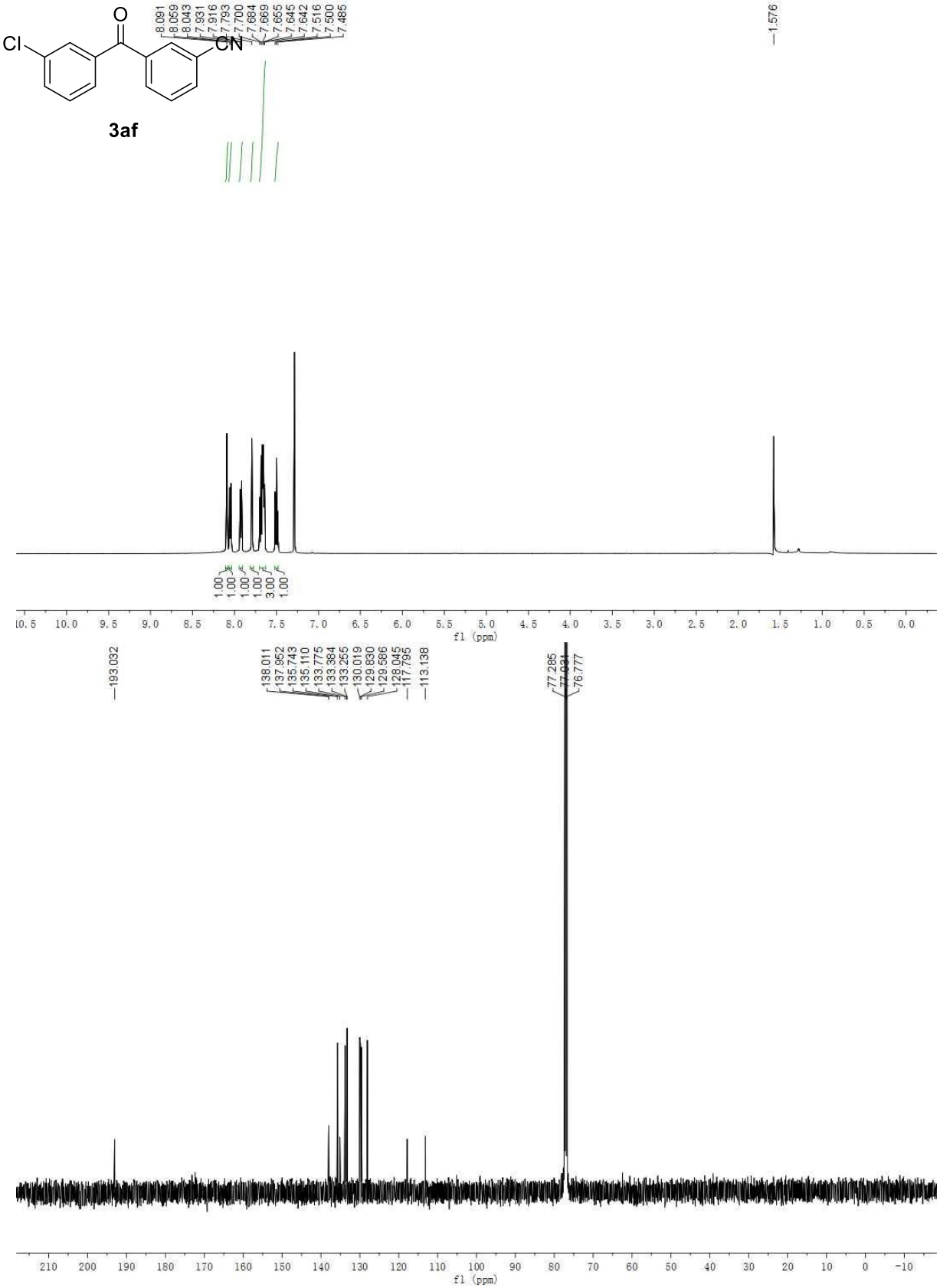

186.830
174.209
163.665
150.357
131.234
130.811
116.124
114.049
77.289
77.035
76.781
55.576
12.951

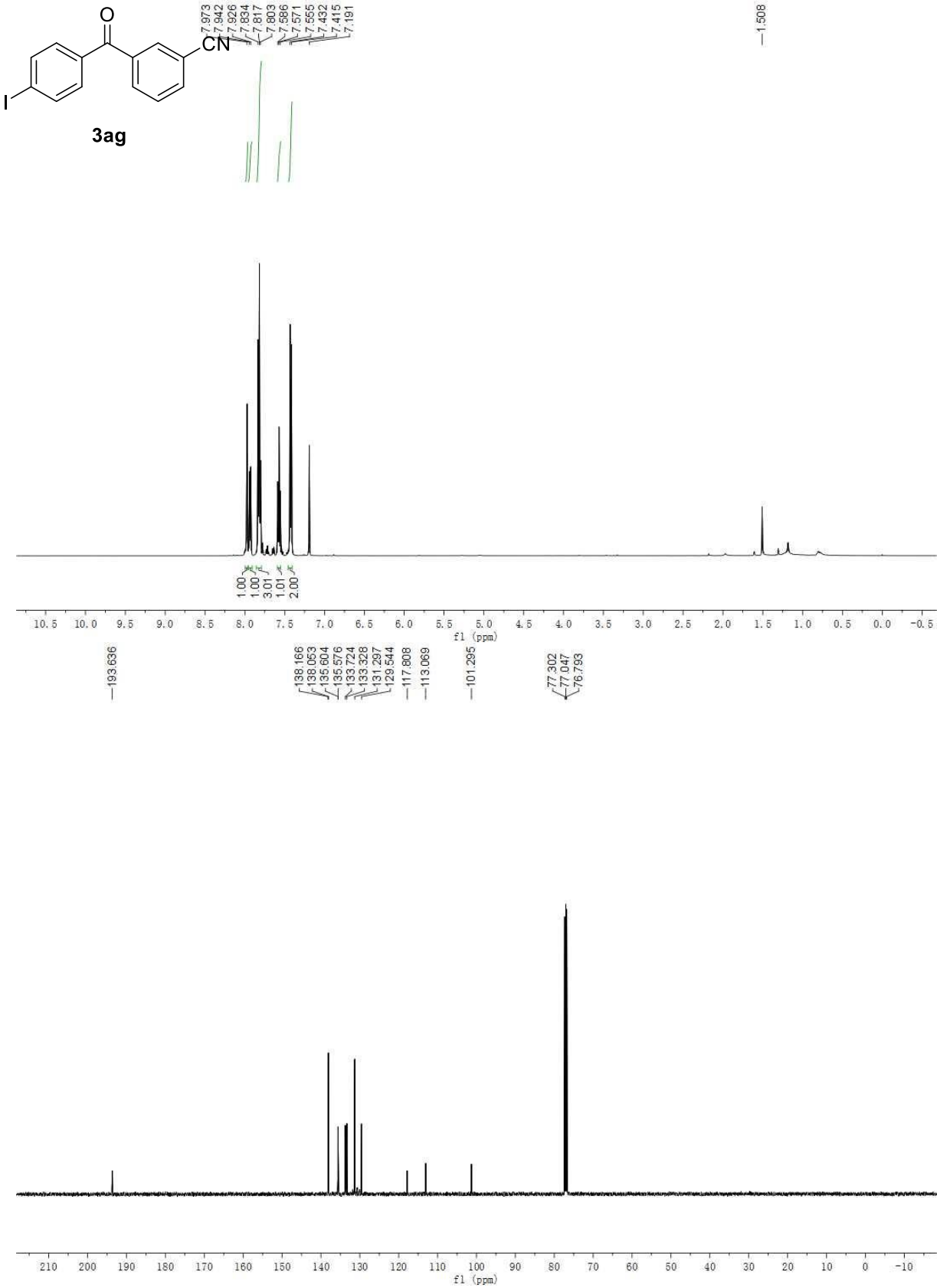

f1 (ppm)

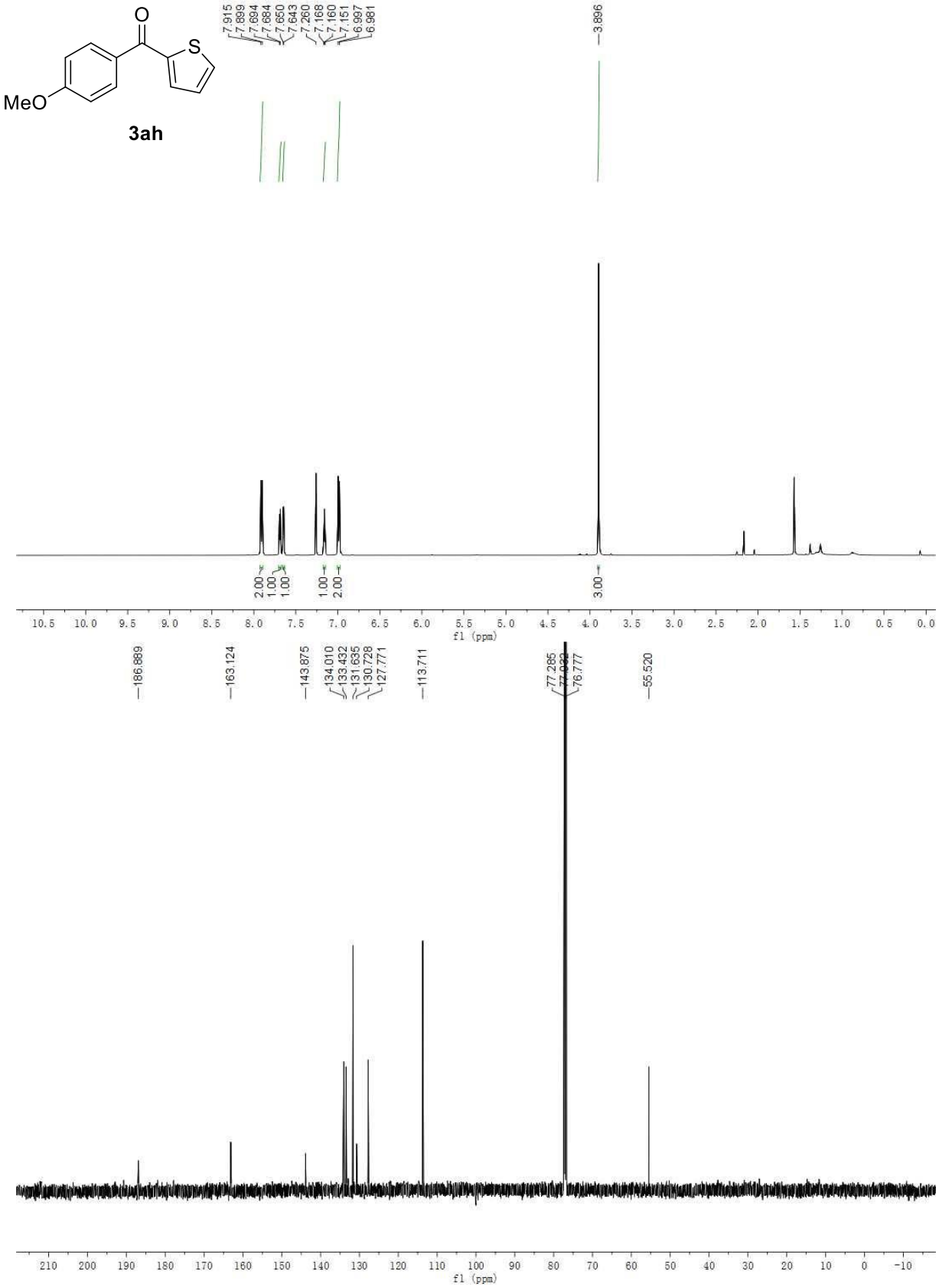

NC
O
OMe
3ac
7.991
7.967
7.951
7.825
7.809
7.775
7.757
7.607
7.591
7.576
7.234
6.975
6.958
3.880
1.00
1.00
1.00
2.00
1.00
2.00
3.00
f1 (ppm)
193.113
163.890
139.385
134.897
133.599
133.153
132.590
129.320
128.936
118.070
113.988
112.711
77.297
77.043
76.789
55.629
f1 (ppm)

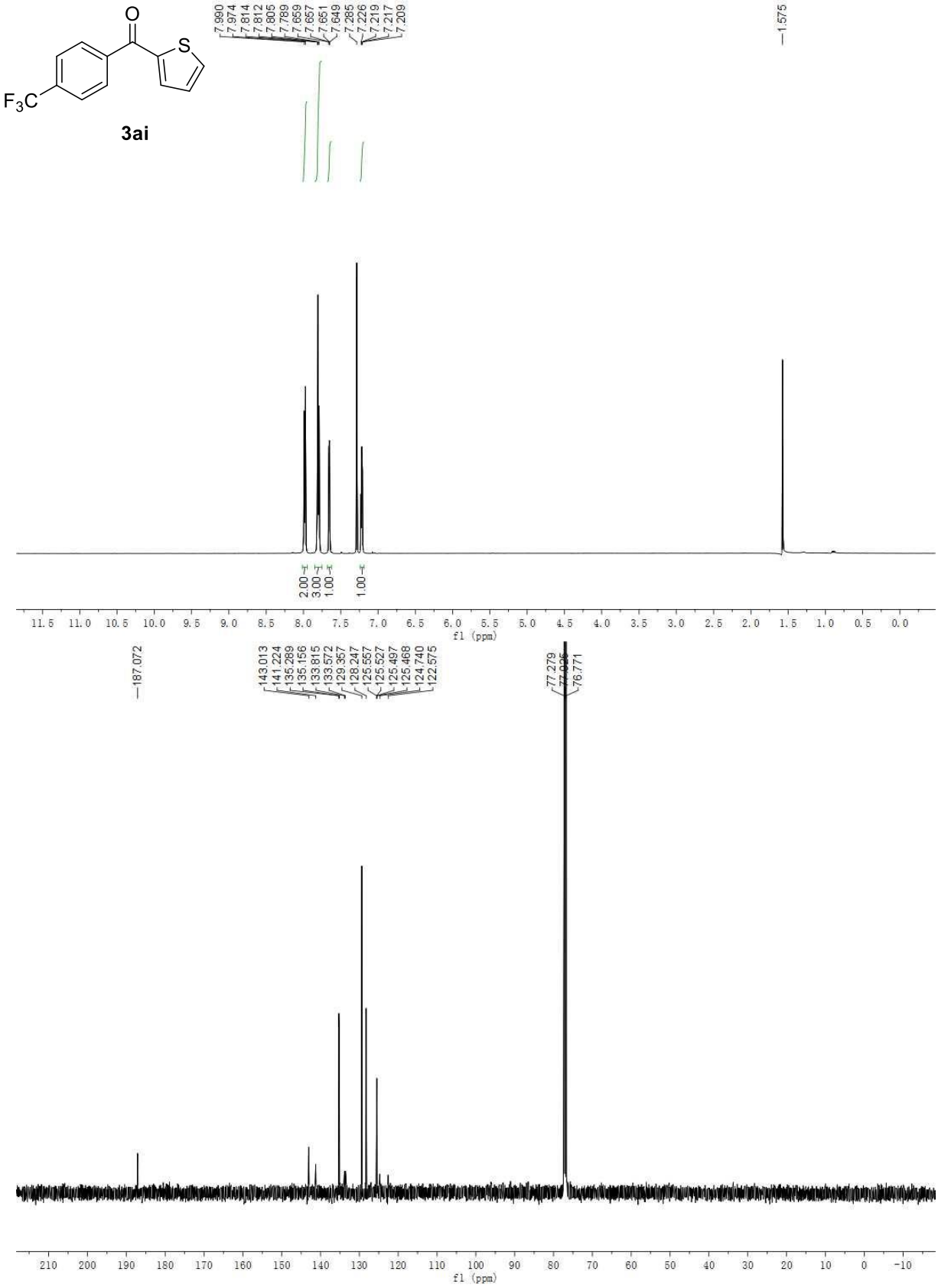

8.001
7.949
7.932
7.917
7.902
7.884
7.617
7.603
7.587
7.568
7.553
7.538
7.260
7.008
6.991
3.907
OMe
3ad
1.00
6.00
2.00
2.00
3.00
f1 (ppm)
195.586
163.244
135.537
135.053
132.623
132.304
131.130
130.461
129.292
128.197
128.063
127.836
126.752
125.919
113.645
77.314
77.060
76.806
55.545
f1 (ppm)

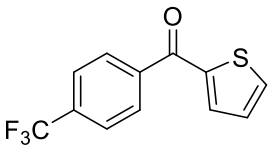

O
CN
O
3ae
8.325
8.251
8.235
7.754
7.753
7.751
7.650
7.349
6.662
6.658
6.655
1.560
1.00
1.00
1.00
1.00
1.00
1.00
1.00
f1 (ppm)
179.864
151.924
147.682
137.960
135.551
133.409
133.074
129.511
121.141
118.018
112.953
112.768
77.284
77.030
76.776
f1 (ppm)


O
Cl
CN
3af
8.091
8.059
8.043
7.931
7.916
7.793
7.700
7.684
7.669
7.655
7.645
7.642
7.516
7.500
7.485
1.576
1.00
1.00
1.00
1.00
3.00
1.00
f1 (ppm)
193.032
138.011
137.952
135.743
135.110
133.775
133.384
133.255
130.019
129.830
129.586
128.045
117.795
113.138
77.285
77.031
76.777
f1 (ppm)


O
CN
I
3ag
7.973
7.942
7.926
7.834
7.817
7.803
7.586
7.571
7.555
7.432
7.415
7.191
1.508
1.00
1.00
3.01
1.01
2.00
f1 (ppm)
193.636
138.166
138.053
135.604
135.576
133.724
133.328
131.297
129.544
117.808
113.069
101.295
77.302
77.047
76.793
f1 (ppm)

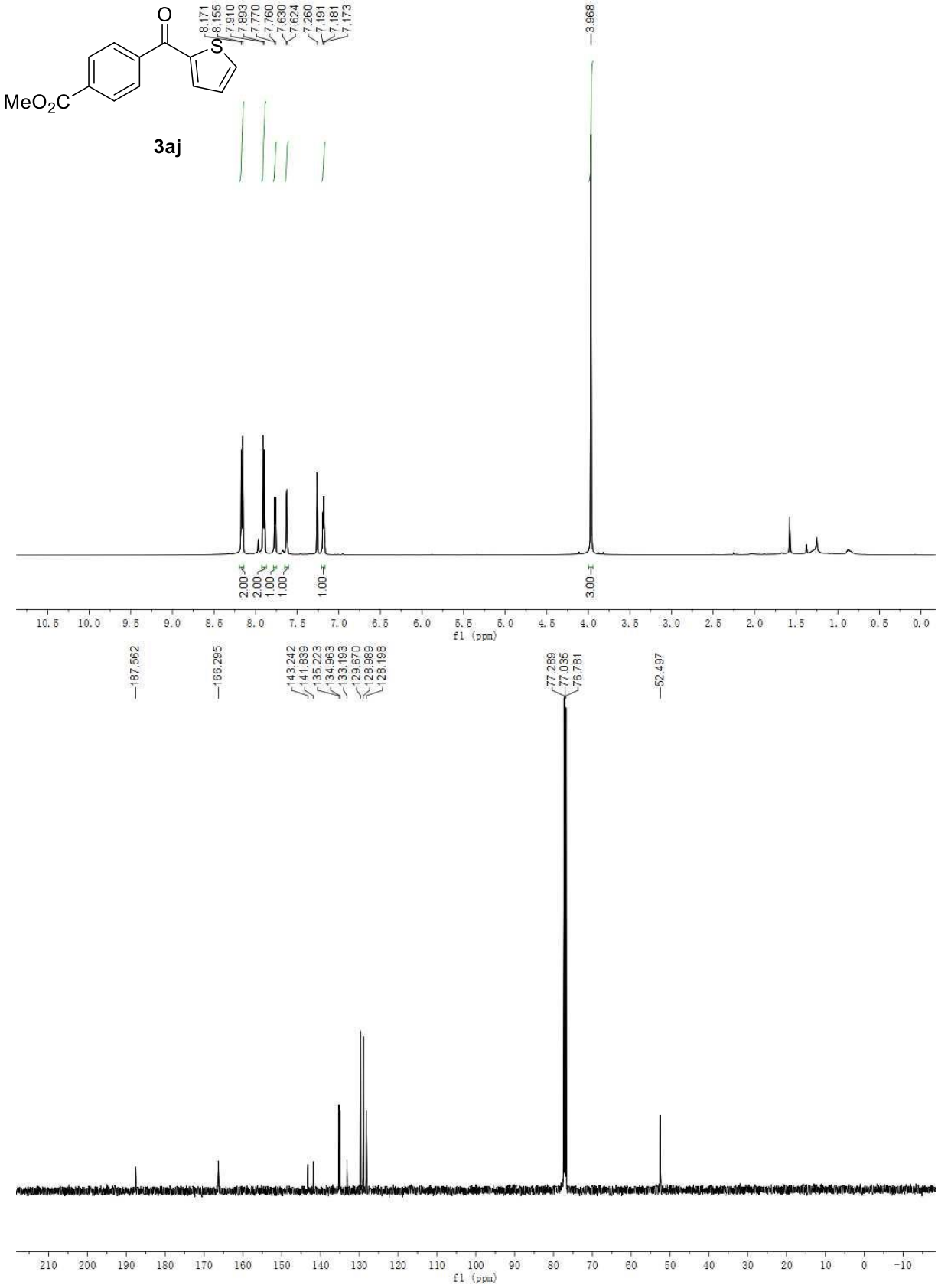

O
S
MeO
3ah
7.915
7.899
7.694
7.684
7.650
7.643
7.260
7.168
7.160
7.151
6.997
6.981
3.896
2.00
1.00
1.00
1.00
2.00
3.00
f1 (ppm)
186.889
163.124
143.875
134.010
133.432
131.635
130.728
127.771
113.711
77.285
77.032
76.777
55.520
f1 (ppm)

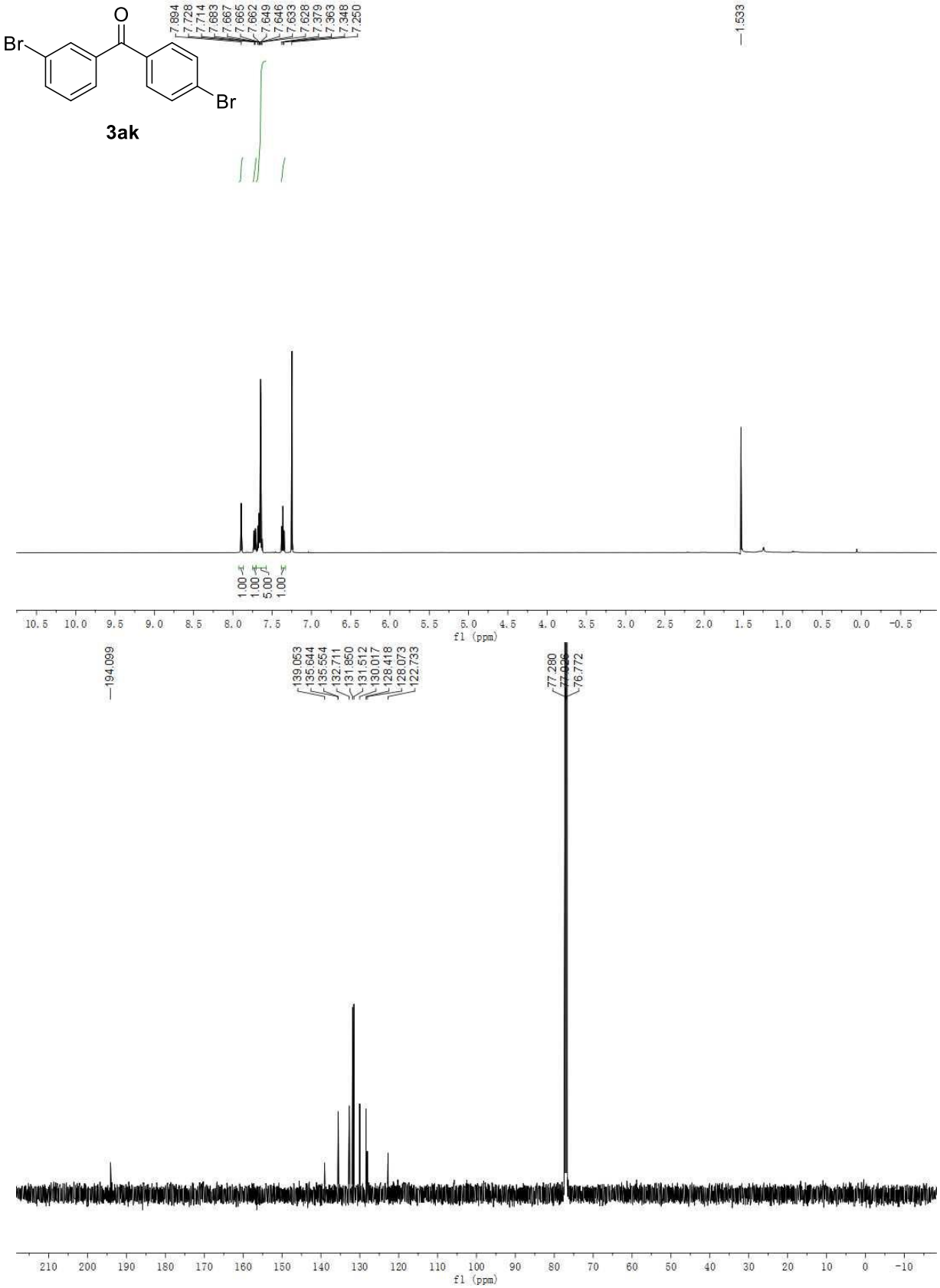

O
S
F3C
3ai
7.990
7.974
7.814
7.812
7.805
7.789
7.659
7.657
7.651
7.649
7.285
7.226
7.219
7.217
7.209
1.575
2.00
3.00
1.00
1.00
f1 (ppm)
187.072
143.013
141.224
135.289
135.156
133.815
133.572
129.357
128.247
125.557
125.527
125.497
125.468
124.740
122.575
77.279
77.026
76.771
f1 (ppm)

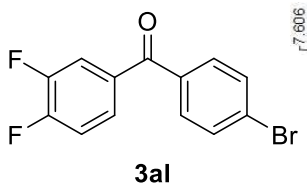

O
S
F3C

3ai

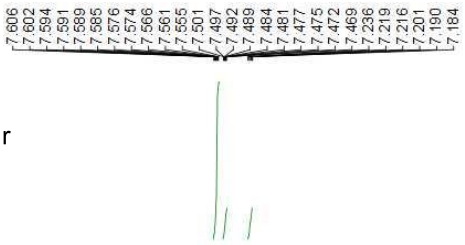
-62.990
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
f1 (ppm)

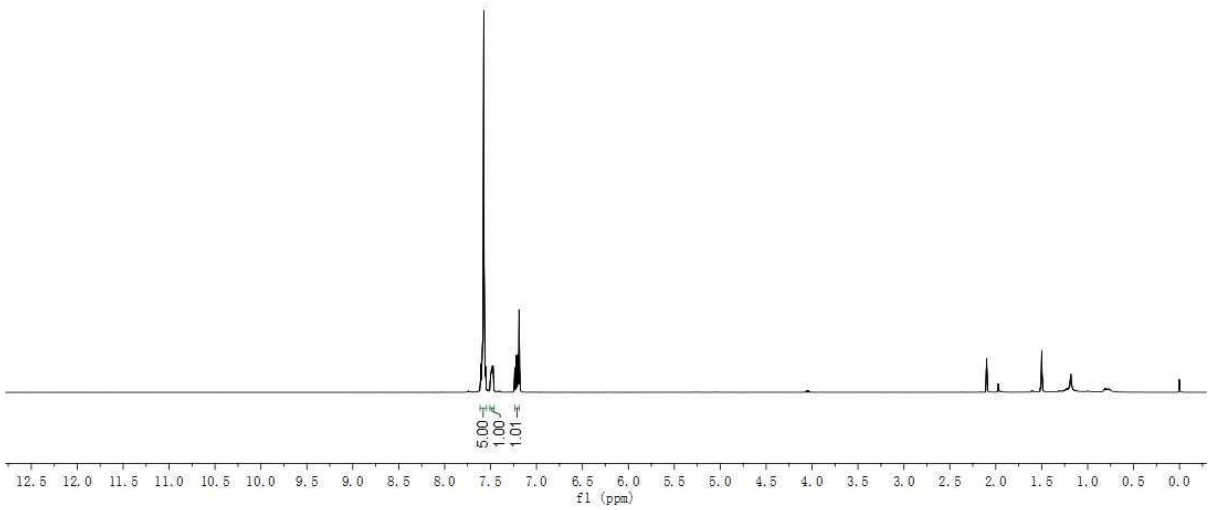

O
S
MeO2C
3aj
8.171
8.155
7.910
7.893
7.770
7.760
7.630
7.624
7.260
7.191
7.181
7.173
3.968
2.00
2.00
1.00
1.00
1.00
3.00
f1 (ppm)
187.562
166.295
143.242
141.839
135.223
134.963
133.193
129.670
128.989
128.198
77.289
77.035
76.781
52.497
f1 (ppm)

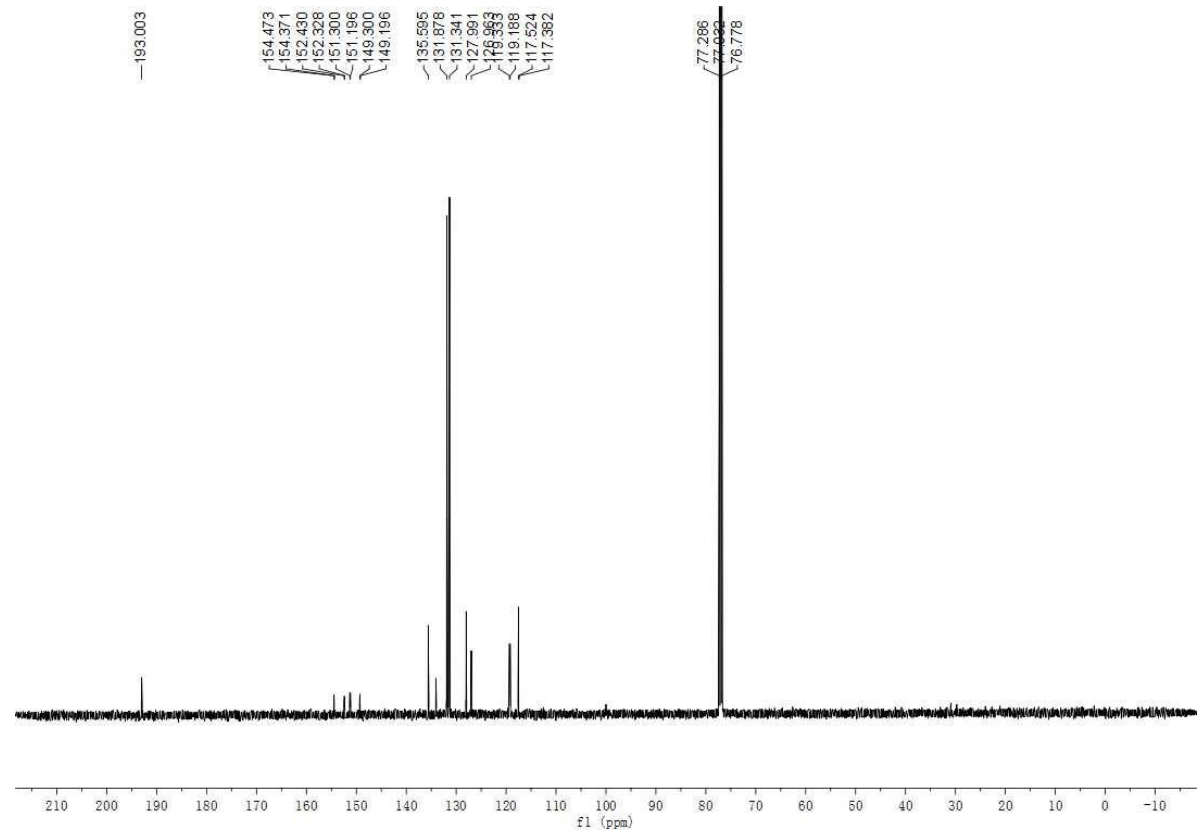

O
Br
Br
3ak
7.894
7.728
7.714
7.683
7.667
7.665
7.662
7.649
7.646
7.633
7.628
7.379
7.363
7.348
7.250
1.533
1.00
1.00
5.00
1.00
f1 (ppm)
194.099
139.053
135.644
135.554
132.711
131.850
131.512
130.017
128.418
128.073
122.733
77.280
77.026
76.772
f1 (ppm)

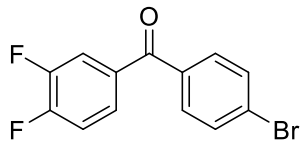

O
F
F
Br

3al


7.606
7.602
7.594
7.591
7.589
7.585
7.576
7.574
7.566
7.561
7.555
7.501
7.497
7.492
7.489
7.484
7.481
7.477
7.475
7.472
7.469
7.236
7.219
7.216
7.201
7.190
7.184

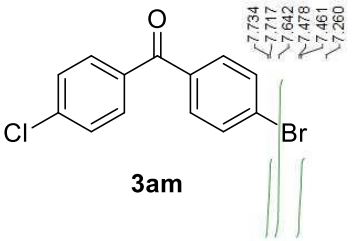

5.00
1.00
1.01
12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


193.003
154.473
154.371
152.430
152.328
151.300
151.196
149.300
149.196
135.595
131.878
131.341
127.991
126.963
119.333
119.188
117.524
117.382
77.286
77.032
76.778
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

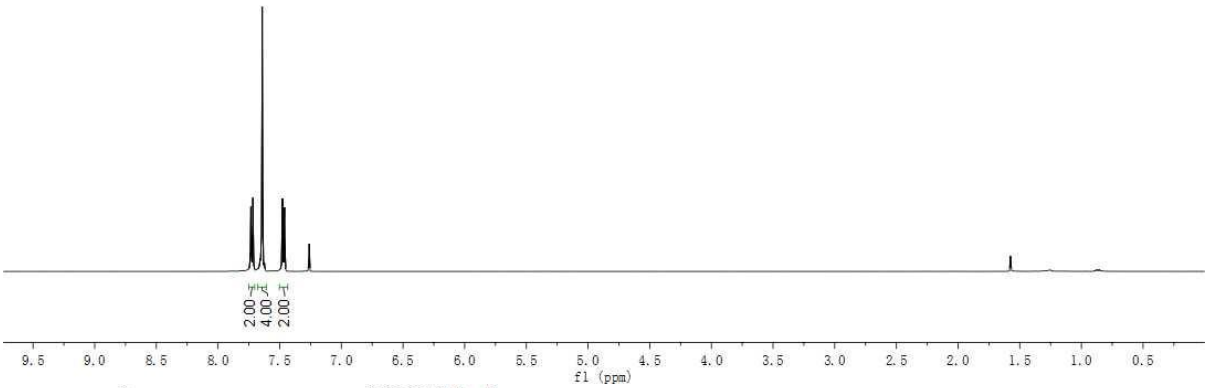

O
F
F
Br

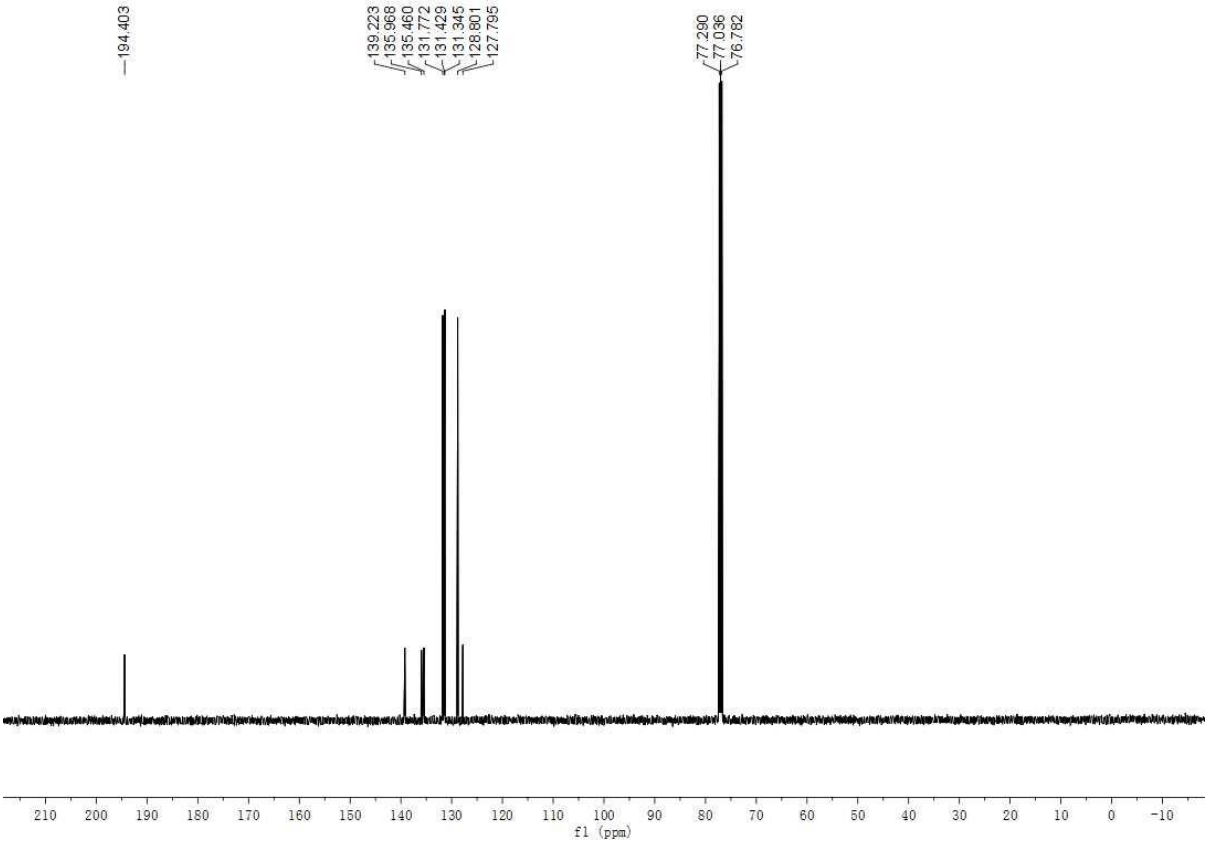
3al

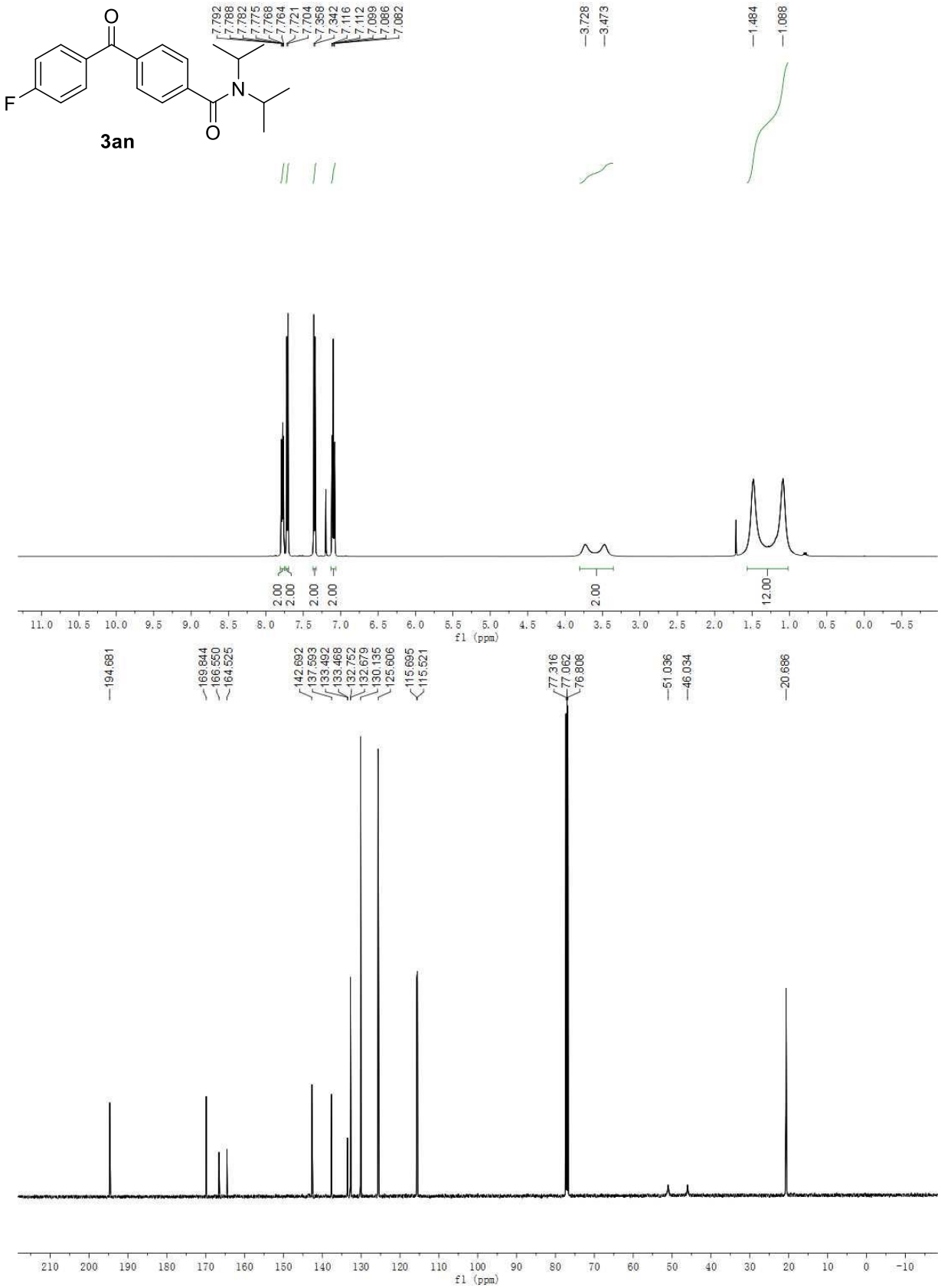
129.925
135.777
-75 -80 -85 -90 -95 -100 -105 -110 -115 -120 -125 -130 -135 -140 -145 -150 -155 -160 -165 -170 -175 -180 -185
f1 (ppm)

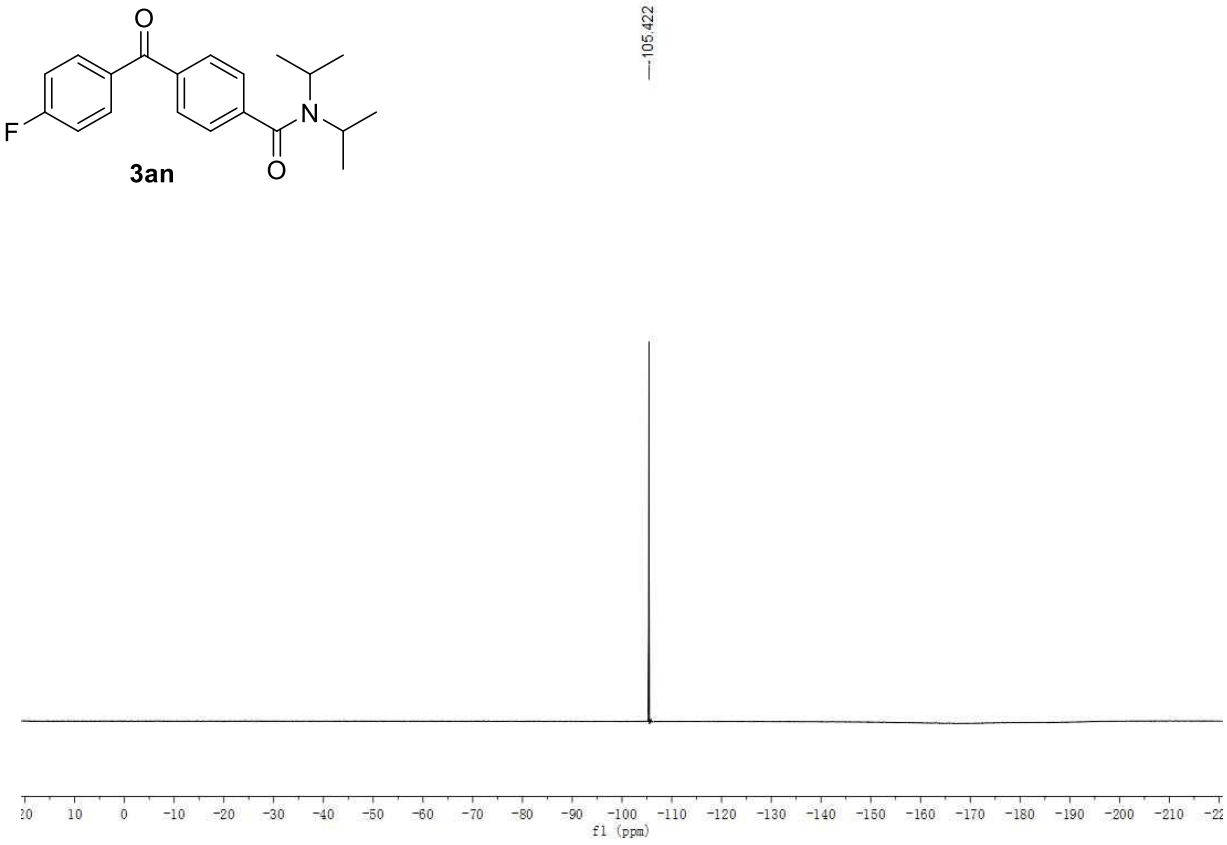

7.734
7.717
7.642
7.478
7.461
7.260
O
Cl
Br

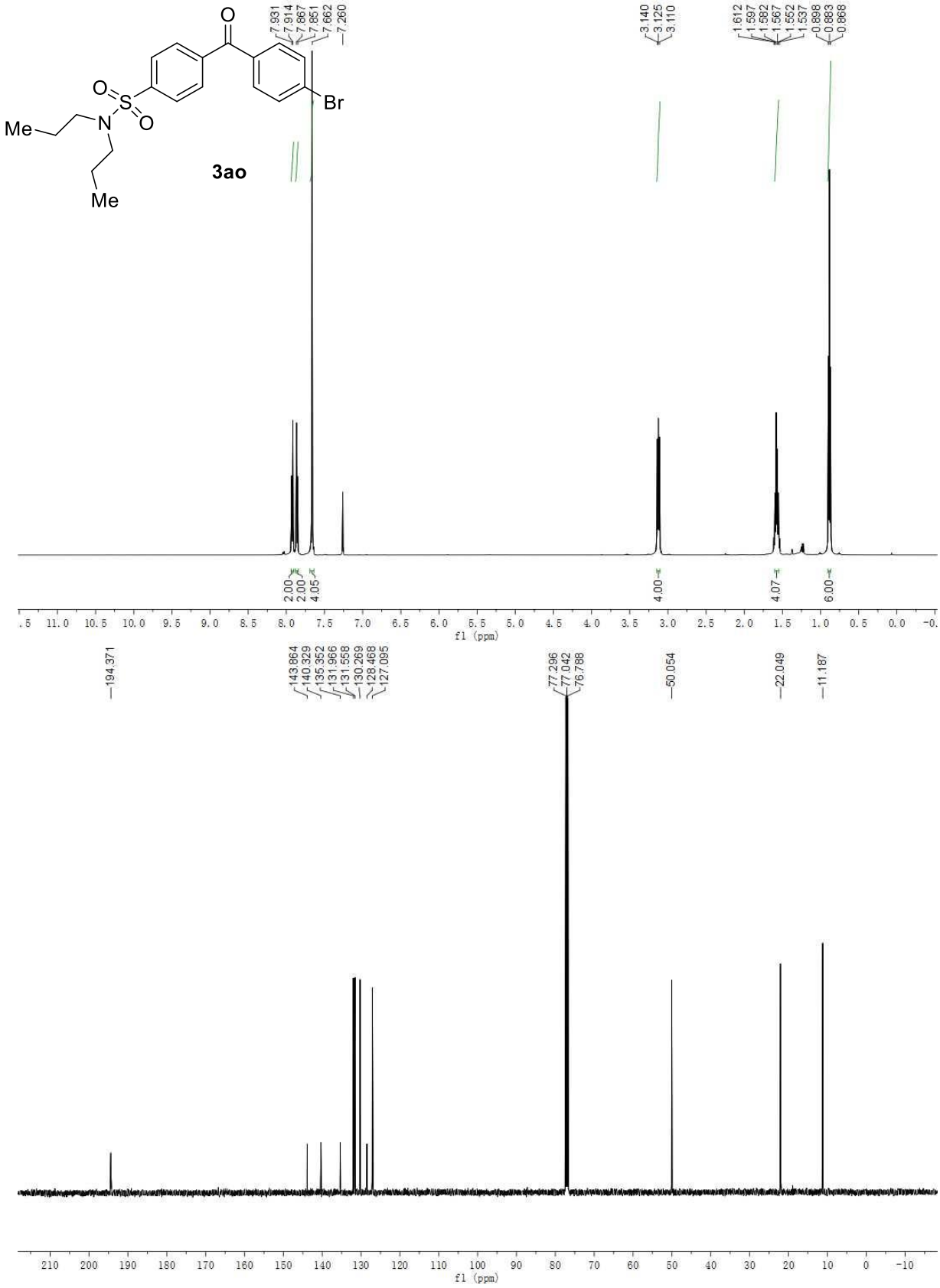
3am

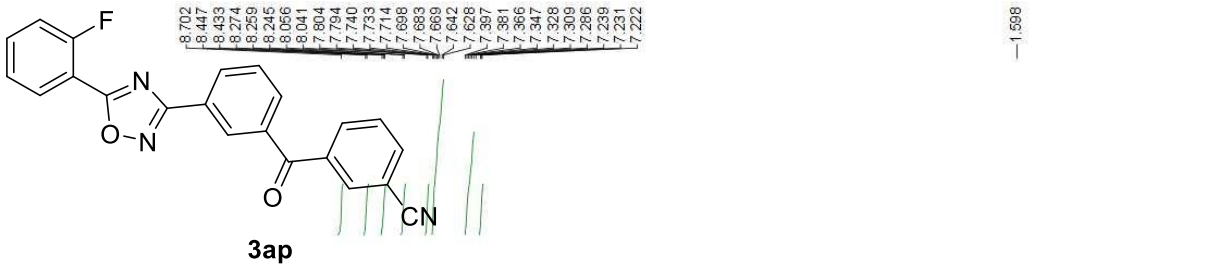

2.00
4.00
2.00
f1 (ppm)


194.403
139.223
135.968
135.460
131.772
131.429
131.345
128.801
127.795
77.290
77.036
76.782
f1 (ppm)

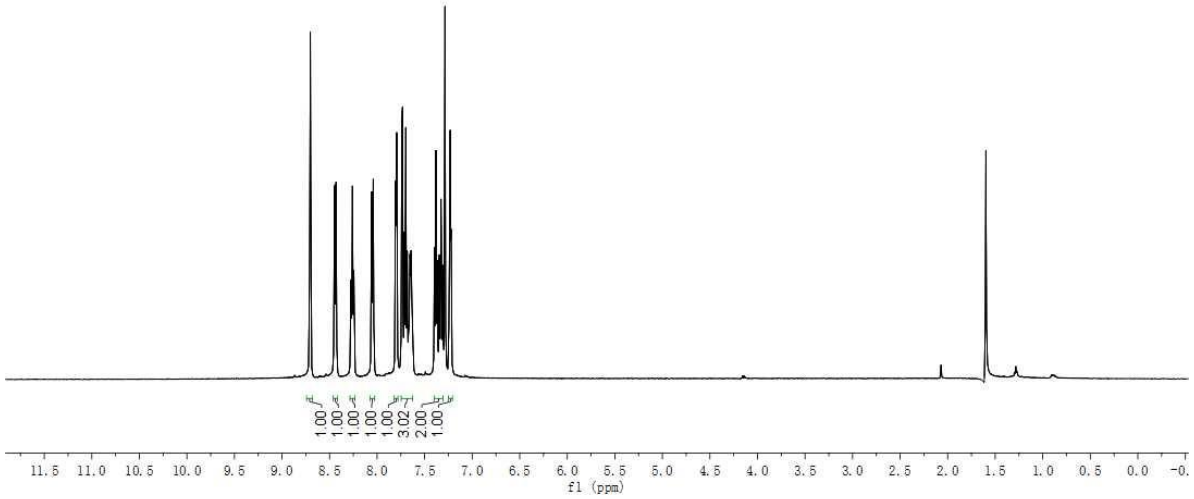

7.792
7.788
7.782
7.775
7.768
7.764
7.721
7.704
7.358
7.342
7.116
7.112
7.099
7.086
7.082
3.728
3.473
1.484
1.088
O
F
N
O
3an
2.00
2.00
2.00
2.00
2.00
12.00
f1 (ppm)
194.681
169.844
166.550
164.525
142.692
137.593
133.492
133.468
132.752
132.679
130.135
125.606
115.695
115.521
77.316
77.062
76.808
51.036
46.034
20.686
f1 (ppm)

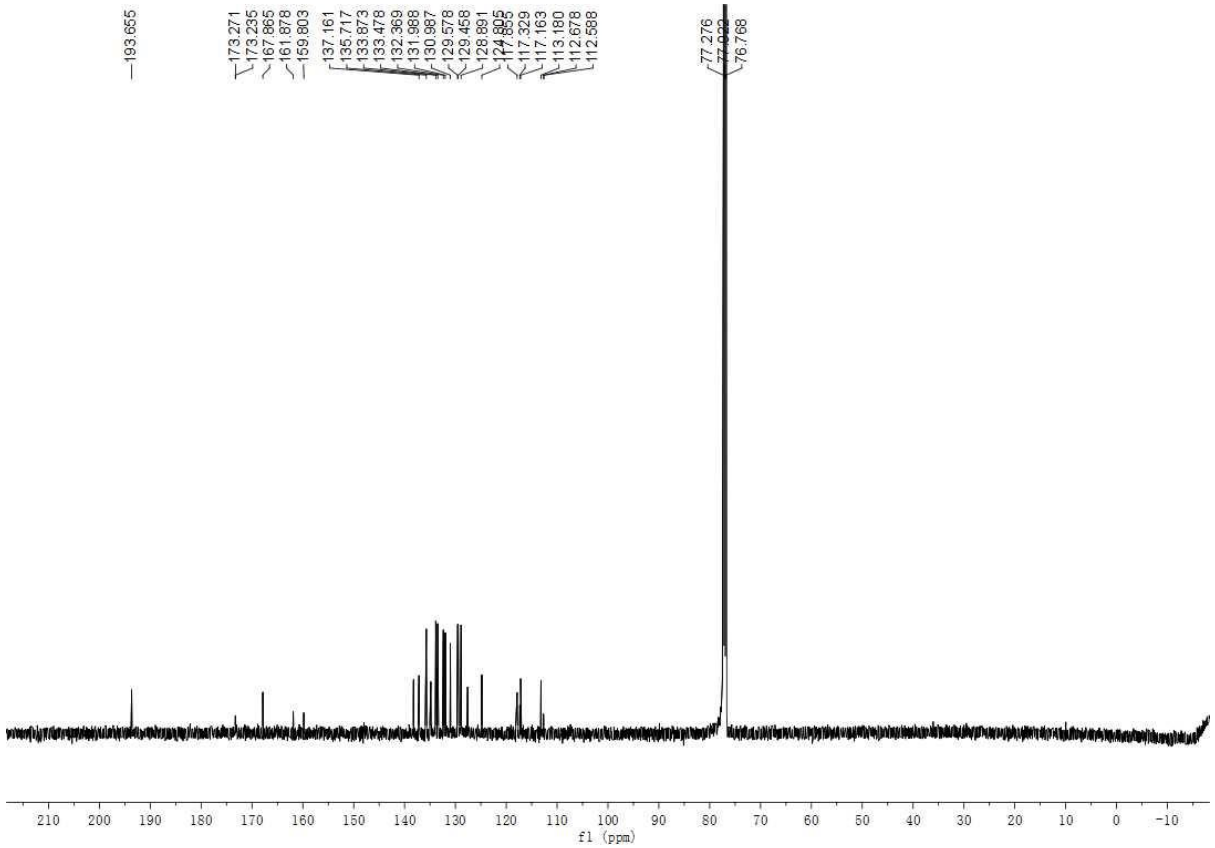

O
F
N
O
3an
-105.422
f1 (ppm)

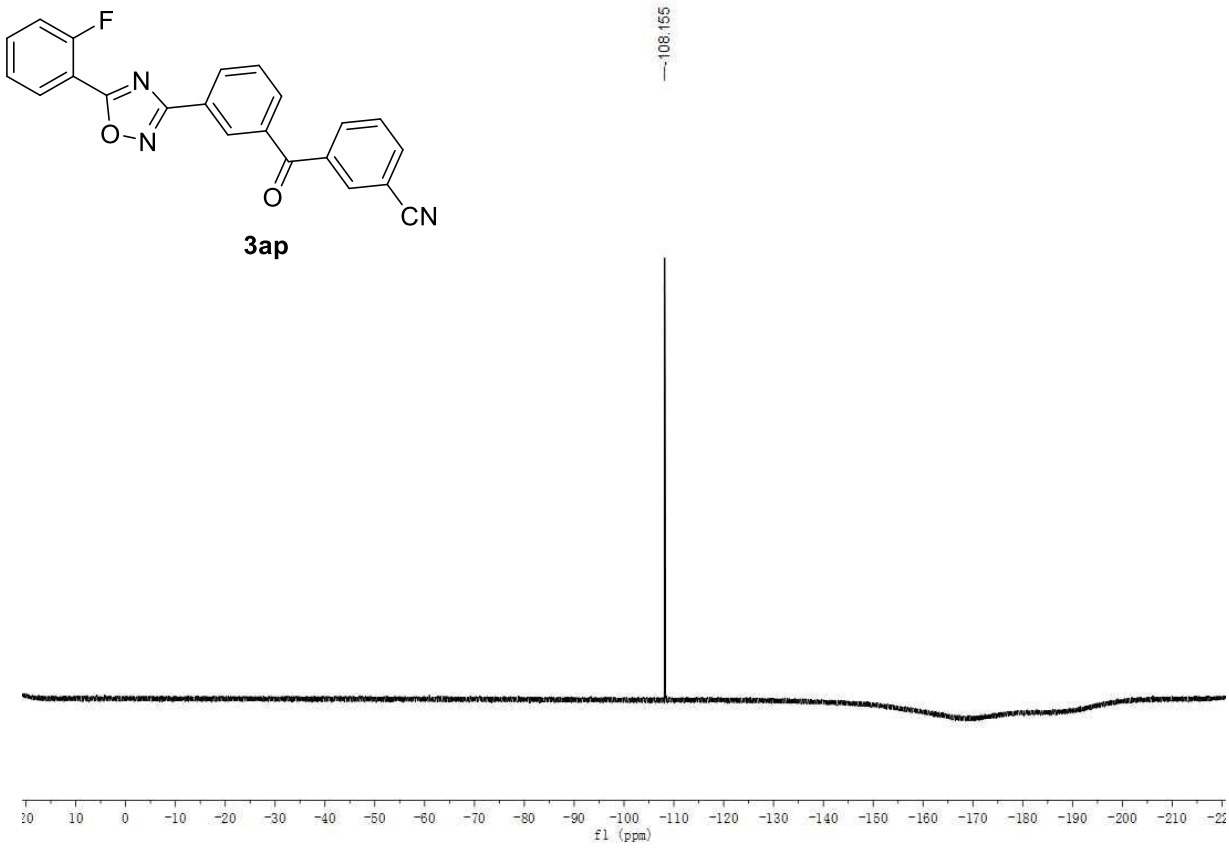

7.931
7.914
7.867
7.851
7.662
7.260
3.140
3.125
3.110
1.612
1.597
1.582
1.567
1.552
1.537
0.898
0.883
0.868
O
O
S
O
N
Me
Me
Br
3ao
2.00
2.00
4.05
4.00
4.07
6.00
f1 (ppm)
194.371
143.864
140.329
135.352
131.966
131.558
130.269
128.468
127.095
77.296
77.042
76.788
50.054
22.049
11.187
f1 (ppm)

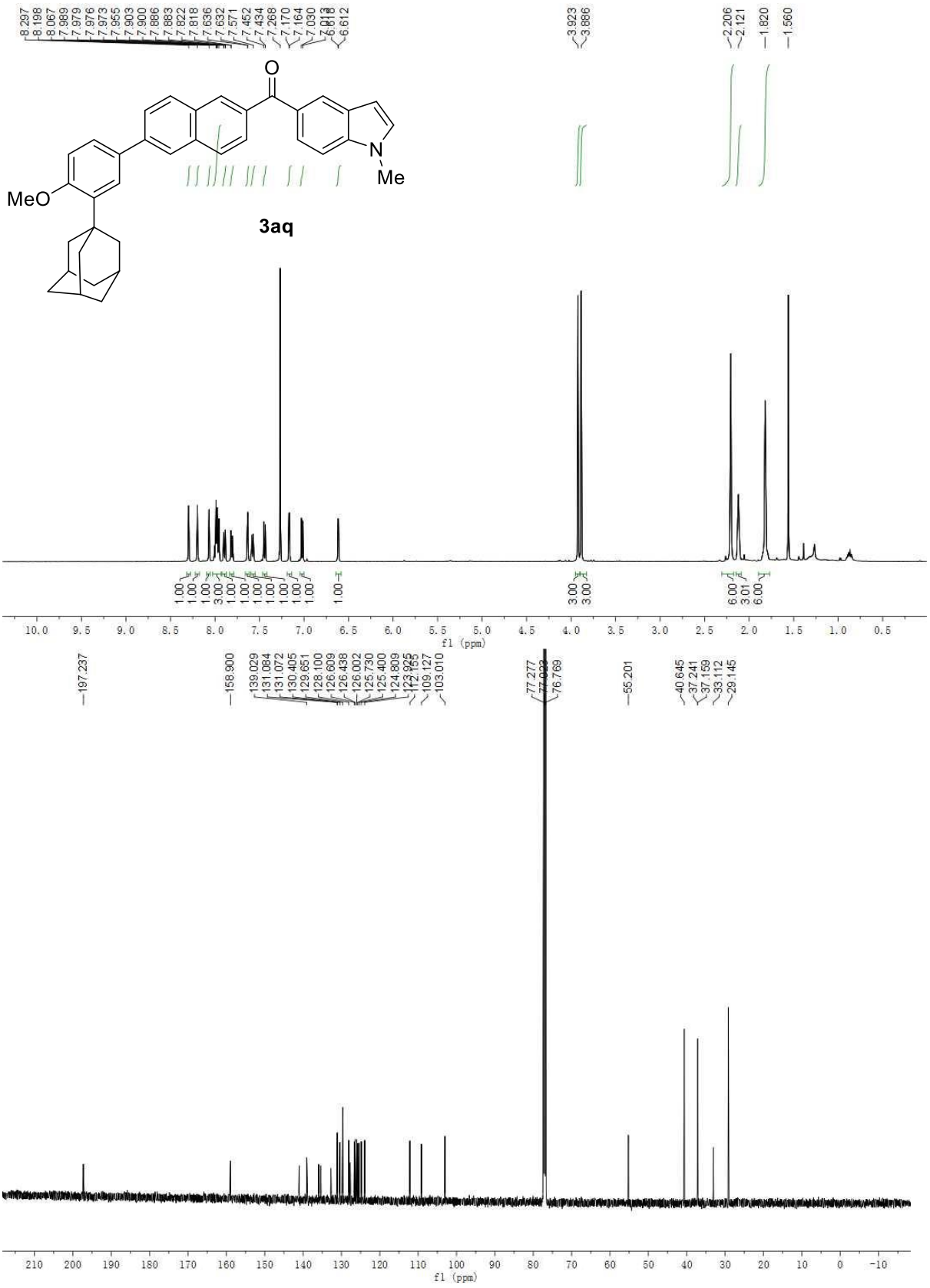

F
N
O
N
O
CN
8.702
8.447
8.433
8.274
8.259
8.245
8.056
8.041
7.804
7.794
7.740
7.733
7.714
7.698
7.683
7.669
7.642
7.628
7.397
7.381
7.366
7.347
7.328
7.309
7.286
7.239
7.231
7.222
1.598

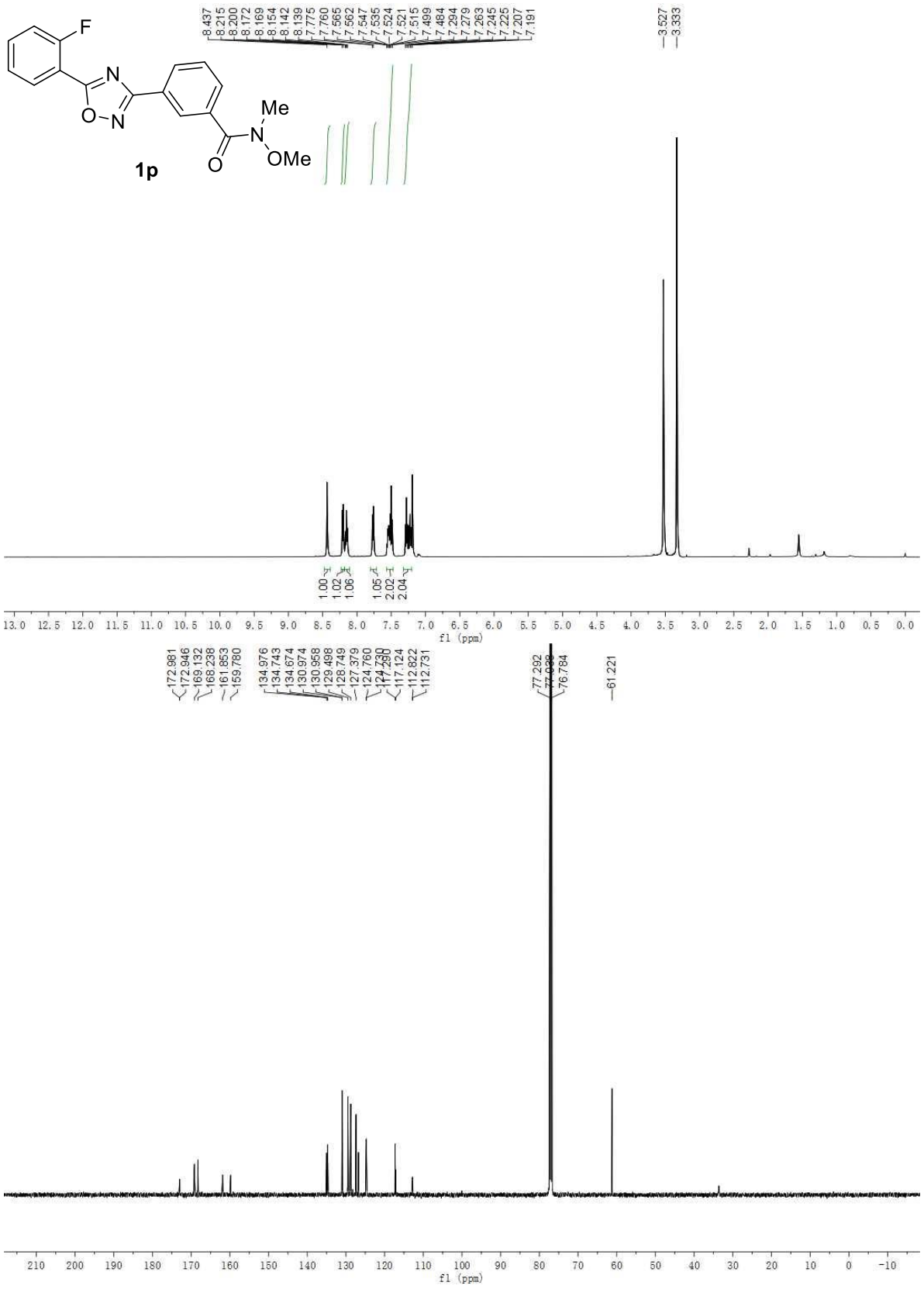
3ap

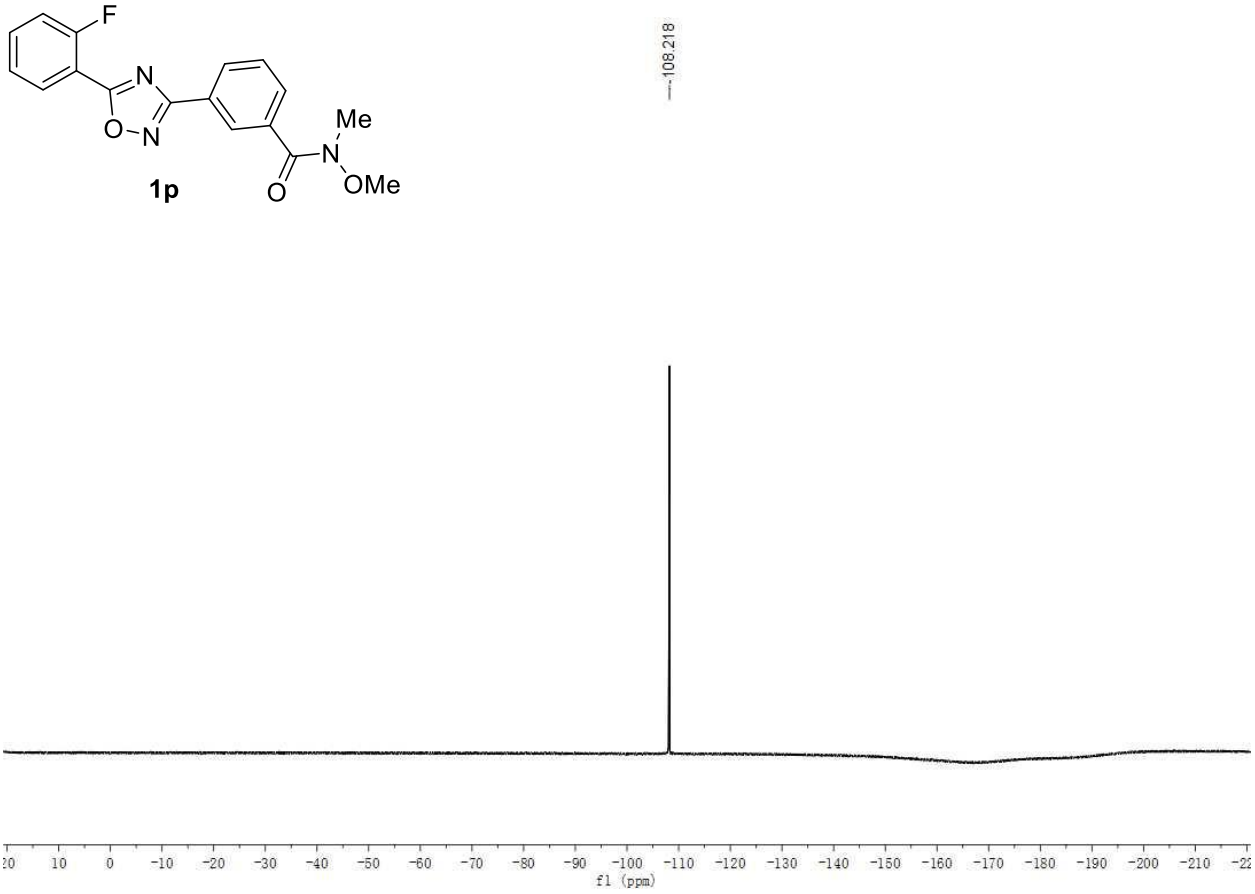

1.00
1.00
1.00
1.00
1.00
3.02
2.00
1.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.
f1 (ppm)

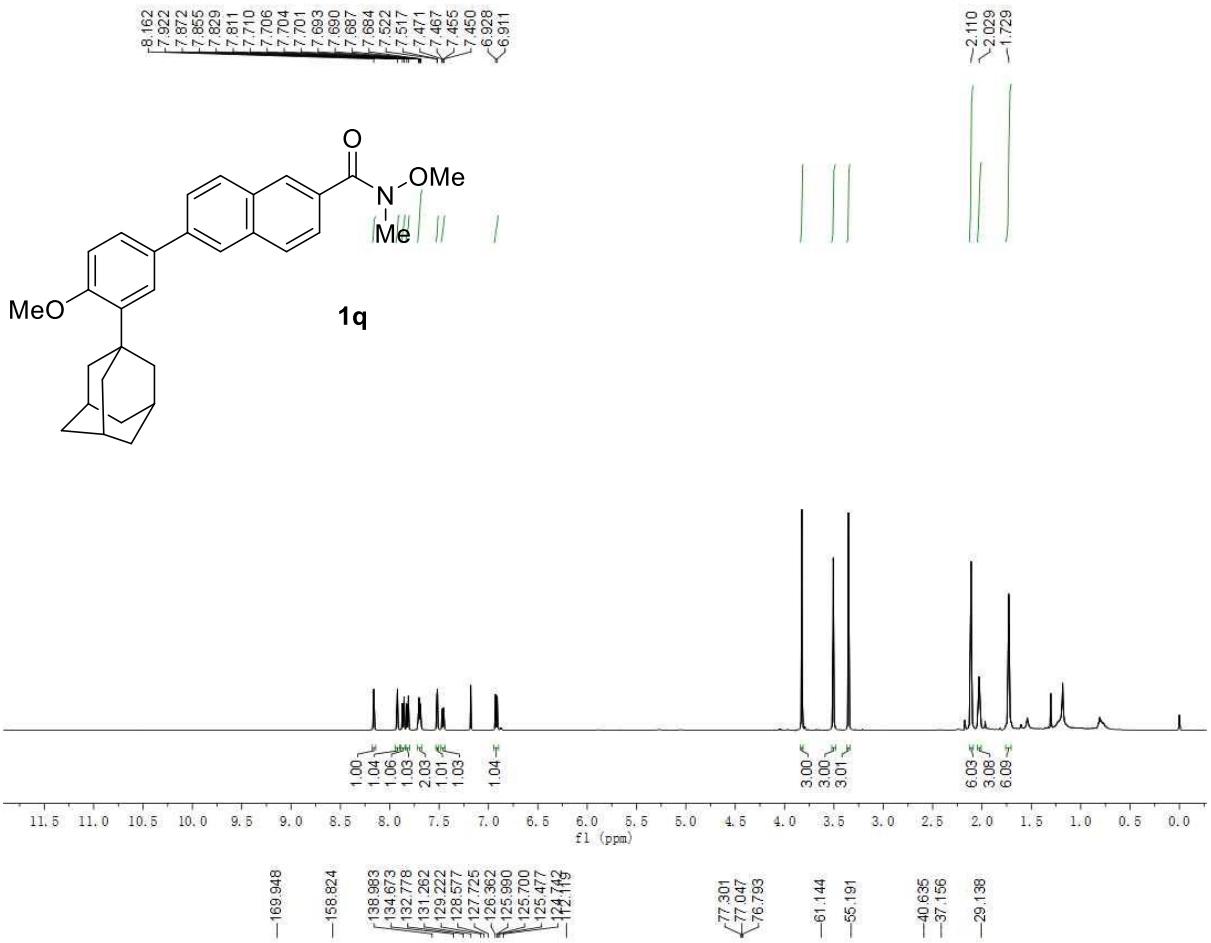

193.655
173.271
173.235
167.865
161.878
159.803
137.161
135.717
133.873
133.478
132.369
131.988
130.987
129.578
129.458
128.891
124.805
124.655
117.329
117.163
113.180
112.678
112.588
77.276
77.020
76.768
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

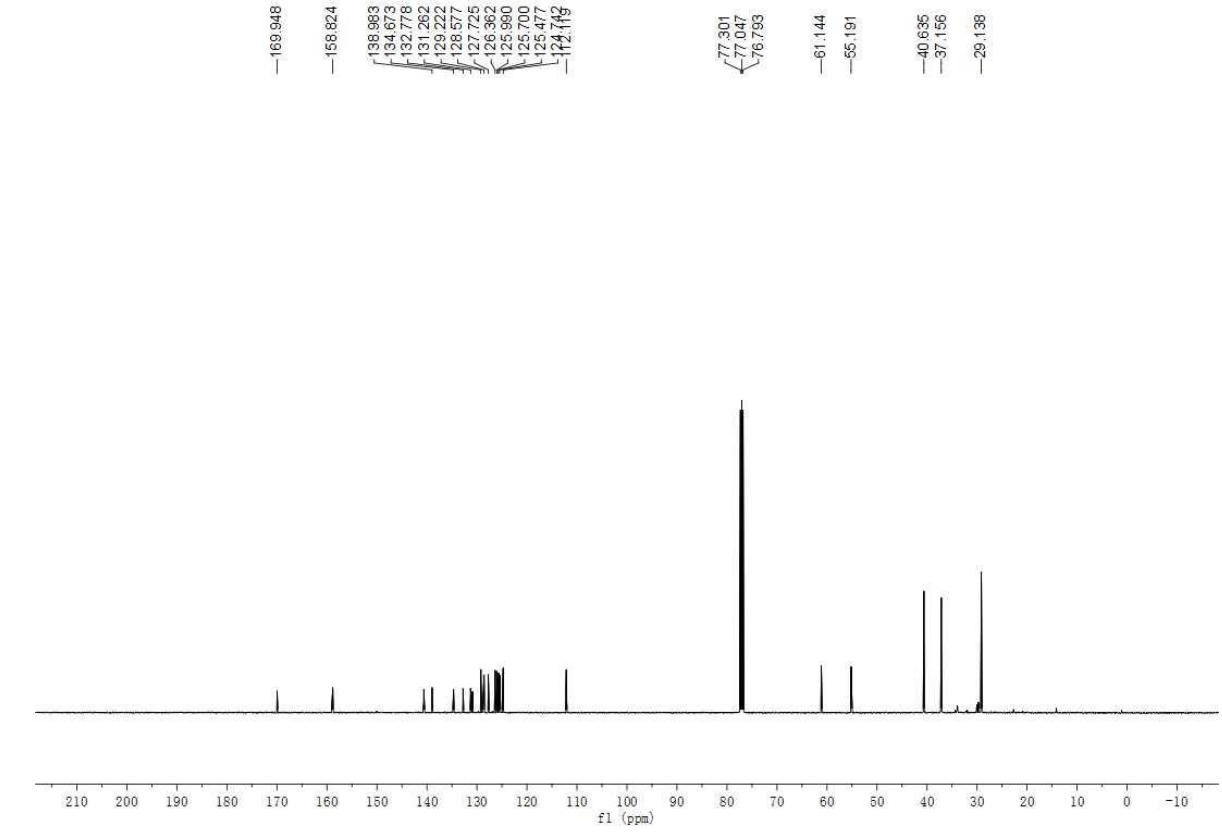

F
N
O
N
O
CN
3ap
-108.155
f1 (ppm)


8.297
8.198
8.067
7.989
7.979
7.976
7.973
7.955
7.903
7.900
7.886
7.883
7.822
7.818
7.636
7.632
7.571
7.452
7.434
7.268
7.170
7.164
7.030
6.818
6.612
3.923
3.886
2.206
2.121
1.820
1.560
O
N
Me
MeO
3aq
1.00
1.00
1.00
3.00
1.00
1.00
1.00
1.00
1.00
1.00
1.00
3.00
3.00
6.00
3.01
6.00
f1 (ppm)
197.237
158.900
139.029
131.084
131.072
130.405
129.651
128.100
126.609
126.438
126.002
125.730
125.400
124.809
112.155
109.127
103.010
77.277
77.000
76.769
55.201
40.645
37.241
37.159
33.112
29.145
f1 (ppm)


F
N
O
N
Me
N
O
OMe
1p
8.437
8.215
8.200
8.172
8.169
8.154
8.142
8.139
7.775
7.760
7.565
7.562
7.547
7.535
7.524
7.521
7.515
7.499
7.484
7.294
7.279
7.263
7.245
7.225
7.207
7.191
3.527
3.333
1.00
1.02
1.06
1.05
2.02
2.04
13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)
172.981
172.946
169.132
168.238
161.853
159.780
134.976
134.743
134.674
130.974
130.958
129.498
128.749
127.379
124.760
124.730
124.290
117.124
112.822
112.731
77.292
77.038
76.784
61.221
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


F
N
O
N
Me
N
OMe
O
1p
-108.218
f1 (ppm)


8.162
7.922
7.872
7.855
7.829
7.811
7.710
7.706
7.704
7.701
7.693
7.690
7.687
7.684
7.522
7.517
7.471
7.467
7.455
7.450
6.928
6.911
2.110
2.029
1.729
O
N
OMe
Me
MeO
1q
1.00
1.04
1.06
1.03
2.03
1.01
1.03
1.04
3.00
3.00
3.01
6.03
3.08
6.09
f1 (ppm)


169.948
158.824
138.983
134.673
132.778
131.262
129.222
128.577
127.725
126.362
125.990
125.700
125.477
77.301
77.047
76.793
61.144
55.191
40.635
37.156
29.138
f1 (ppm)